ineering
rary

DEC 16 1924

Founded March 1, 1874—Fifty Years of Service

Electrical World

McGraw-Hill Company, Inc. *December 13, 1924* Twenty-Five Cents Per Copy

DUNCAN

Watthour Meters

Combine in a unique way many elements of design and operating principle which contribute to the greatest degree of accuracy and working efficiency, and which are gaining increased recognition as indicated in the present trend of meter development.

DUNCAN ELECTRIC MANUFACTURING CO., LAFAYETTE, IND.

In the interest of Safety and Economy

here are twelve reasons why central stations should install the Metropolitan AA Rotary Meter Switch.

1. Underwriters "AA" rating — highest possible.
2. Protects against fire.
3. Makes service costs practically negligible.
4. Protects utility against unauthorized tampering with service.
5. Has investment features which offer large inducements to utilities.
6. Improves service.
7. Releases crew of trouble men for more productive duties.
8. Eliminates many complaints.
9. Protects against personal hazard.
10. Prevents broken seals.
11. Has all the advantages of a circuit breaker.
12. Builds public good will.

Remember it's the last cost that counts. The first cost of a meter test switch is only half the story. Purchase one that pays back it's initial cost by reducing emergency calls and still is safe and tamper-proof,—the Metropolitan AA Rotary Meter Switch.

For our latest bulletin and working model use the coupon.

METROPOLITAN DEVICE CORPORATION
1250 Atlantic Avenue, Brooklyn, N. Y.

Gentlemen: Please send me without obligation a miniature working model of the Metropolitan AA Rotary Meter Switch.

Name ..... Company .....

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

Volume 84 New York, Saturday, December 13, 1924 *Number* 24

Heaven Deliver Us from Our Friends!

AMONG the commoner uses of electricity is its employment for light, heat and power. For these purposes it is unsurpassed. Its application for heat, however, ideal and perfect as it is, has been limited by its cost. Nothwithstanding this, in industrial processes the advantages of electric heat are oftentimes sufficient to warrant its use over less costly competitors. The heating of homes by electricity in all parts of the country where freezing temperatures prevail is an expensive luxury under any circumstance of production; indeed, considering that in only two states—Montana and Idaho—is all of the electricity generated from water power, the use of electricity for heating houses is an economic crime. Fully 80 per cent of all the electricity generated by electric light and power companies in this country east of the Rocky Mountains comes from fuel, so that only the very rich could afford the luxury of electric heat. When, therefore, friends of the industry mislead the public as to the possibilities of heating houses by electricity we must cry out: "Heaven deliver us from our friends!"

Traffic Control and the Electric Light and Power Company

STREET lighting has long been an important, and frequently a spectacular, service rendered to its community by an electric light and power company. It has been the principal opportunity for the company to make a public and practical contribution to the solution of a civic problem. But there are strong indications that another opportunity is at hand—and that lies in signal lighting for traffic control. It is no idle prediction that in public service, though not in revenue, it may eventually be almost as important as street lighting itself.

Traffic control is coming to be more and more electrically operated and to be almost universally conducted by electric light signals. But there is a woeful lack of standardization in these signals in color, form, location and operation, until the confused motorist who travels from city to city finds himself outguessed in nearly every case. In individual cities, in fact, constant change is the order of the day. There is thus a real opportunity for the electric light and power company to study and familiarize itself with this problem so that it may be in a position to make recommendations. There is a science in the color and intensity and form of signal light that is a part of the electric lighting—or, at least, of the illuminating engineering—field. A recent paper read by C. A. Halvorson before the Illuminating Engineering Society points out some of the elements of the problem and makes constructive suggestions.

The company which anticipates the traffic signal problems in its own community will benefit both in good will and in revenue and will help to build the community.

Accounting System for Small Utility Companies

ALTHOUGH the uniform classification of accounts adopted by the National Association of Railroad and Utilities Commissioners is applicable to the smaller utilities, the latter have complained of its inapplicability, chiefly because the larger system was not reduced to a simplified form. Such a simplified classification has now been produced by the commissioners' association. It is based on the larger classification and does not depart from its uniformity. The major subjects only are taken, but the classification permits of elaboration of those accounts, in conformity with the general classification, when the growth of the utility company demands it.

At the convention of the National Association of Railroad and Utilities Commissioners held at Phoenix, Ariz., last month this simplified classification was presented and adopted. It fills a long-felt want among the smaller utilities and should be speedily adopted and applied except where conflicting statutes call for some modification. Thus all the utilities, both large and small, in the twenty-four states which have adopted the commissioners' classification will be following a uniform accounting system of proved worth—one which has the indorsement of the National Electric Light Association and of the American Gas Association.

The Ever-Increasing Tax Burden

PRESIDENT COOLIDGE in his annual address to Congress made the necessity of government economy and tax reduction his leading theme, stating that "the government can do more to remedy the economic ills of the people by a system of rigid economy in public expenditure than can be accomplished through any other action." And, to show the true status of affairs, he said: "The costs of our national and local governments combined now stand at a sum close to $100 for each inhabitant of the land" and that "a little less than one-third of this is represented by national expenditure and a little more than two-thirds by local expenditure. It is an ominous fact that only the national government is reducing its debt. Others are increasing theirs at about $1,000,000,000 each year."

Here is a situation which is of special interest to privately owned public utilities. Every one knows we have had a war which accounts for most of our national debt. What is not generally known, however, is that state and local taxes are so much greater. Public utili-

ties are the largest taxpayers in the community, and while they do not object to paying taxes, they have a right to insist that the local tax burden shall not be made heavier, but, in keeping with the national economy, lighter. This duty, which every electric light and power company owes to its patrons, should not be shirked. Higher taxes mean higher rates, and the onus should be placed where it belongs by the utility company, which unfortunately acts as an indirect tax gatherer.

Electric Shovels Prove Economical

IN THE larger sizes, particularly, the electric shovel is rapidly finding a large field of application in mining work. It has been found very economical to operate and splendidly adapted to mining conditions and, after a hard fight, has been accepted by mining men in all parts of the world. The development of the control for the electric shovel was a real achievement, for it must satisfy many trying specifications and many arduous operating requirements. The duty cycle is very severe. The shovel must dig into iron ore, rock or other hard substances, must hoist the loaded shovel and at the same time swing the boom, and then, after unloading, must quickly return to its initial position. All this must be done by control of one operator in such a manner that a very delicate control and quick response shall be had and yet no damage result from the shovel striking alternately hard and soft material. Not content with accomplishing all this, the electrical designers have been able to use synchronous motors to good advantage on electric shovels. These motors drive shovel equipment or motor-generator sets and at the same time correct for poor power factor when the load is light.

Experience with strip coal mining in Pennsylvania, iron-ore mining in Michigan and Chile and copper mining in Utah and other regions gives data to show that the electric shovel is a very satisfactory piece of equipment and comparatively inexpensive to operate and maintain. Although higher in first cost than the steam shovel, it has a lower maintenance cost, greater delicacy in control and moves more material per unit of time. The fields of application of the electric shovel have only been touched, and the lessons learned in the mining industry should be applied to all types of construction work.

Helping Structural Engineers with Arc Welding

MUCH of the technical discussion at the last meeting of the American Welding Society in Cleveland centered on the use of electric arc welding in the fabrication of steel structures. As in other applications of electricity, no little missionary effort will be required, but present experience indicates that the electrical profession may safely urge the use of welded joints in place of rivets in many cases, at a considerable saving in labor cost and in the weight of the finished structure.

One of the handicaps which every new application of electricity has had to meet has been the one figuratively and biblically termed pouring new wine into old bottles. It was necessary at first to fit electric bulbs into old kerosene lamps, electric motors into turtle-speed machine tools, and make domestic appliances look just like those of the housewife's grandmother. However, as soon as the superiority of electricity had been demonstrated, lighting fixtures appeared that were especially adapted to electric lamps, machine tools were radically redesigned, and washing machines ceased to look like "electrified washtubs." In all these cases electrical men had to take the matter into their own hands and learn the science of illumination, the art of cutting metals and the sport of Monday morning washing.

It is safe to prophesy that history will repeat itself in the application of electric welding to the gigantic industry of fabricating and erecting structural-steel parts. At first the change will merely mean replacing rivets here and there by welded joints; then present-day structural forms will be entirely welded, and finally new structural forms will be designed particularly adapted to welding. Those interested in the spread of this branch of the art may as well accelerate this slow historical process and, anticipating the inevitable trend, begin right now evolving new structural forms and joints particularly adapted to welding processes. The shapes, joints and practices which came into being with the riveting process will pass into oblivion with rivets.

Investigations of Lighting Are Excellent Theses for Students

MOST of the work which college students have presented to them is of a nature which leaves little room for judgment. The answers to the problems are arrived at directly and with certainty, and in most cases the correct answers would all be alike even though a thousand students had worked them out independently. Perhaps this is a necessary or unavoidable condition of college courses; nevertheless, it cannot be denied that after the student leaves college most of the problems which he meets are less well defined and are solved only by compromising various factors. This requires judgment.

Theses give students an opportunity to use judgment in making assumptions or in compromising important factors. Furthermore, it is possible to suggest topics for theses which invade the economic side of civilization —a phase which is not overemphasized in college. Investigations of lighting have the advantage of requiring little equipment besides a portable photometer, a tape and a notebook. Opportunities are to be found on every hand and particularly in the larger cities. An analysis of the lighting of the schools or the libraries, with recommendations for improvement, involves many interesting phases, and the results might be welcomed by the authorities. A survey of the daylighting of an office building and a comparison of its cost and shortcomings with the cost and advantages of artificial lighting is an interesting economic problem. The wasted space devoted to natural lighting in stores, hotels and other buildings is another worth-while study. The influence of cloudiness and of the season on the cost of artificial lighting is of direct concern both to central-station companies and to consumers.

The relation of lighting to production is very important, and progressive managers of factories could be interested in such a study. Street lighting and traffic accidents are related, and city officials should welcome

an analysis on these lines. Lighting is, indeed, so essential a factor in modern life that it affords many opportunities for theses of technical and economic interest. It is so intricately interwoven with eyesight and other things that it is far from an exact science, thereby calling for much judgment in weighing its various elements. Engineering faculties should find many advantages in assigning such theses as those suggested to their students.

Precautions in Resuscitation

SEVERAL examples may be cited where the victim of electric shock has been resuscitated immediately after the shock and yet has died later because ordinary precautions were not observed. For example, the placing of the victim on his back in an ambulance sometimes leads to death even after the prone-pressure method has succeeded in reviving him. The jar of the ambulance and the position of the patient may cause the tongue to fall back and prevent breathing, or the cessation of the resuscitation process may permit a relapse into coma.

Every precaution should be used to continue the mechanical process of resuscitation to its final stages, for, like cranking an automobile, it frequently requires several starts to insure the smooth and continued operations of the human engine. In safety work of this character there must be no lapse of attention until the patient has fully recovered, and the good work done immediately after an accident should be continued until there is no possible chance of a relapse.

Get the Horses Pulling in the Same Direction

SOMETIMES it seems a mystery why there is so much difficulty in determining the proper basis on which to formulate rules regulating overhead construction. The subject is of special interest at the present time because of the work on rules of this character going on in several states and because of the revision of the National Electrical Safety Code which is being conducted according to the procedure previously prescribed by the American Engineering Standards Committee.

While personal opinions, pride of individual accomplishment and like factors help to muddy the waters, the chief difficulty is the inability or unwillingness of all persons involved to get down to the facts that ought to be easily obtainable. All kinds of line construction have been built up on a cut-and-try basis. Only in the past few years has there been much of an effort to apply to line structures methods really embodying engineering design. These have been confined largely to the important transmission lines. Little or no effort has been made to build up a consistent analysis of the vast body of actual experience available in the files of every wire-using company so that safe minimum standards for construction purposes can be erected upon a solid basis of fact.

As a result engineers who ought to be able to agree on the facts of experience and their significance are actually fighting over personal opinions. One group builds a logical and fine-looking mathematical theory that is based on structural facts applying to other types of structures. Another group builds up what seems to it a proper practice to protect its own property and disregards the effect on public service of utilities as a whole. Still another group urges something that, on analysis, may be found to be based on personal pride in doing something different from what has been done before.

If the money and time that have been thus spent in the last fifteen years could have been concentrated and properly applied to research work, the object sought could have been found long ago. That object is a proper set of minimum requirements that will be good from the standpoint of safety and service and will not impose on utilities an unnecessary investment. As the situation now stands it seems that the various utilities involved will continue trying to settle the problem to suit individual viewpoints and in so doing will get nowhere.

It is time that some of the effort and money hitherto expended by power, communication and transportation utilities in fighting one another be devoted to the research and analysis that must be completed to obtain the facts essential to an amicable agreement among utilities as a whole.

Grounded Neutral Should Not Be Abandoned Without Good Substitute

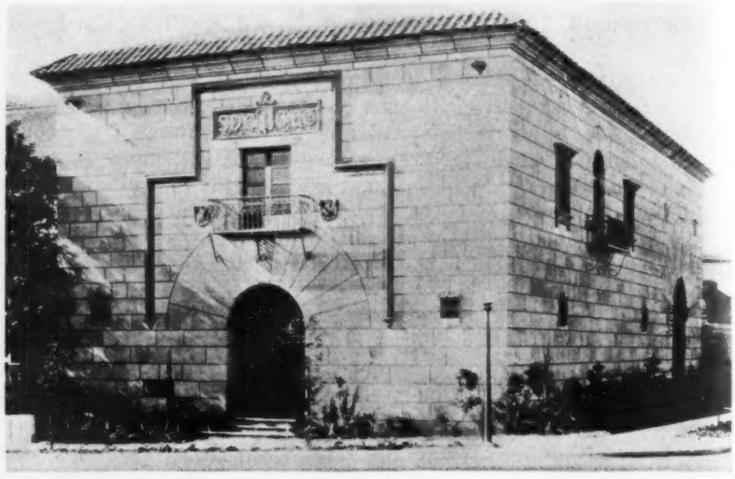
SEVERAL power companies have reported requests to them to put resistance in their neutral grounds to prevent inductive interference in telephone lines paralleling their power lines. These requests are for resistors of several hundred ohms and generally of a value that requires complete revamping of the power-system relays. The question arises, "Is it possible to comply with the request without actually destroying the value of the neutral ground?"

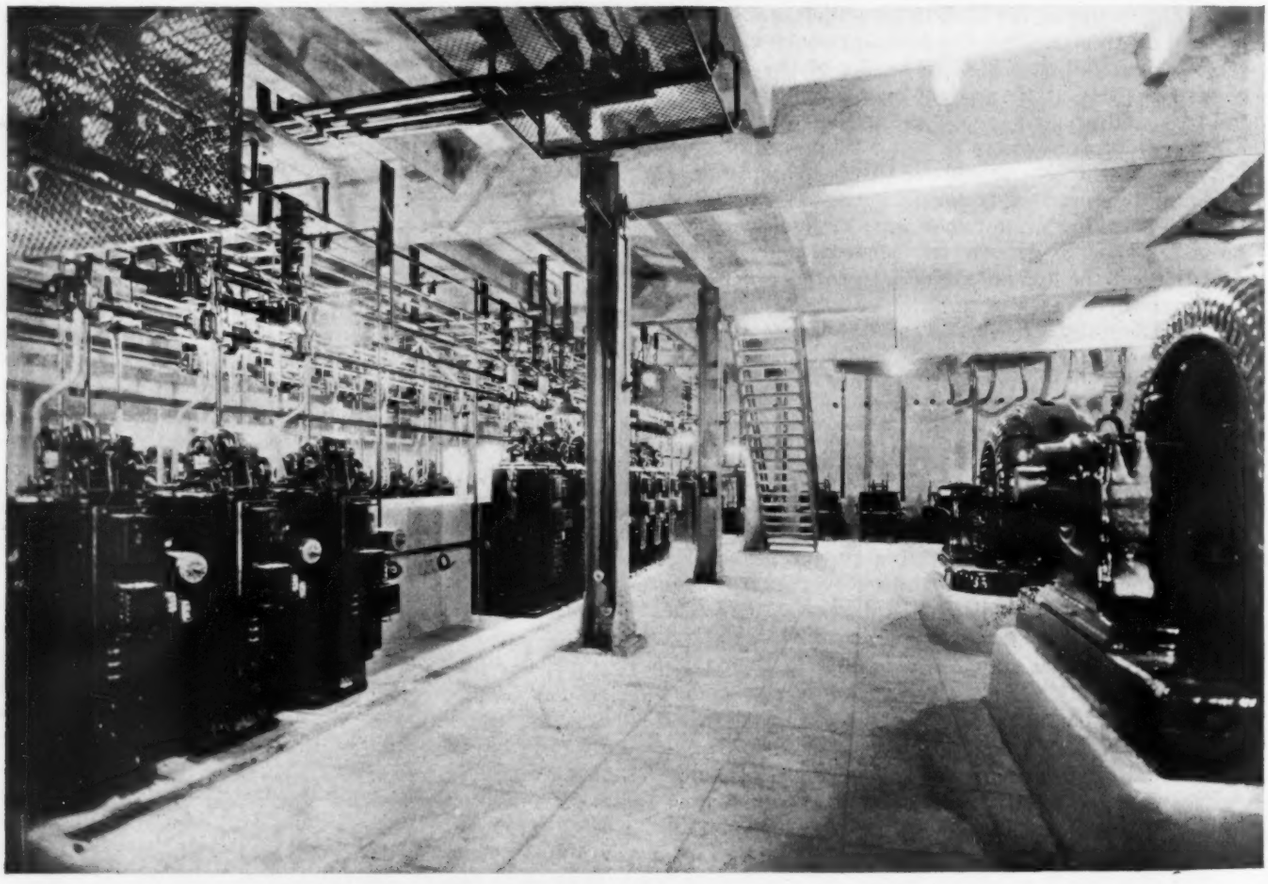
When the isolated neutral is used, no trouble is encountered so long as the system capacities are small, because there is not enough power behind the excess voltages during abnormal conditions to cause breakdowns of apparatus. However, there comes a time in the growth of any considerable system when this is no longer true and the effects of high-voltage surges begin to be felt in apparatus or insulation breakdowns and consequent serious service difficulties.

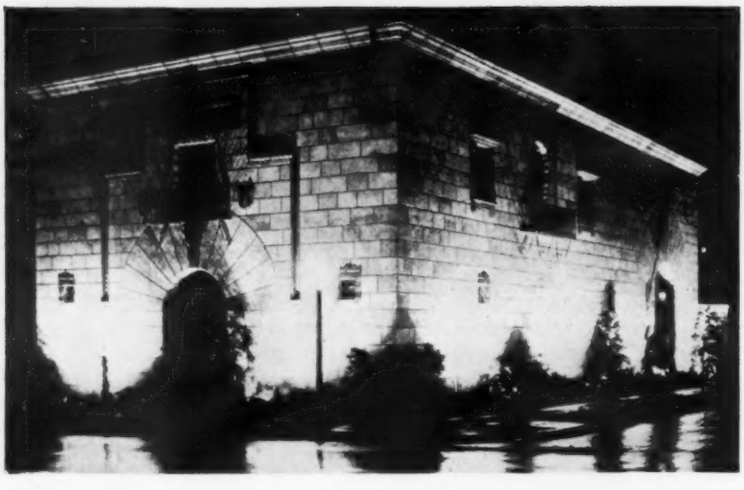
Grounding of the neutral substitutes excess current conditions for excess voltage, and with properly designed and adjusted relay systems the faults that occur are cleared promptly and without damage to apparatus. Since the ordinary system is designed for a dead-grounded neutral, the insertion of resistance at once makes a change in conditions toward those found in the isolated system. How far the move is in this direction depends on the system characteristics and the amount of resistance. The values usually requested as necessary to reduce inductive interference are sufficient to justify an inquiry into whether the move is not one toward the use of the isolated-neutral system.

The neutral ground on power systems has met a need for protection of apparatus and service that should not be ignored except for the strongest of reasons. In any case some substitute for it which is equal in value must be found before a demand is made for its abandonment. Its elimination cannot be asked merely on the ground that the ungrounded circuit causes less noise in parallel telephone circuits.

Attractive Substation in Residential District of San Diego







HOW to secure and maintain the spirit of amity so essential between utilities and customers is a subject that has claimed a great deal of attention. As summed up by some utility executives, it involves doing the little things well. One of these is to make the architectural design of plants and buildings placed within city limits acceptable to the public eye.

Naturally, the question arises: Does it cost more to construct a building that has an attractive outward appearance, and, if so, is the additional cost justified? The Byllesby Engineering & Management Corporation has furnished an answer to that question in station C at San Diego, erected near an exclusive residential neighborhood. The engineering department of the Byllesby corporation estimates that the cost of this attractive station, built in the Spanish style prevalent in California, was not more than 10 per cent greater than the cost of the usual type of substation.

Economics of Power-Factor Correction

Where and Why Power-Factor Correction Should Be Applied—Method of Computing Cost and Analysis of Typical Installations—Recommendations for Use as Regards Type and Location of Corrective Equipment

By RAYMOND C. R. SCHULZE
Engineering Department, Duquesne Light Company

THE advantages to be gained by the use of power-factor corrective machinery are universally understood, but this equipment involves an investment and the question arises as to whether or not the saving effected will pay for the investment cost of the apparatus. There are many factors to be considered when studying the economics of an installation and various ways to calculate the possible saving and to draw general conclusions concerning the type and method of installing power-factor corrective apparatus. The following analysis takes some of these elements into consideration and attempts to evaluate them in a logical way.

The economic study of a corrective installation involves several items in many different ways. By reason of brevity these may be listed as follows:

(a) Fixed cost of corrective equipment.
(b) Energy loss cost in corrective equipment.
(c) Possible saving in line loss.
(d) Saving in transformer energy loss.
(e) Saving in power station capacity because of (1) lower kva. in generators, (2) lower kw. line loss.
(f) Improvement of regulation.
(g) Increased capacity of lines and transformers, with the same losses as before, due to the improvement of power factor.
(h) Increased output per ampere transmitted after the power factor is corrected.
(i) Increase in the most economical load for the transmission line, probably at a lower cost per kw. transmitted.

Items (a) and (b) can be balanced against (c), (d), (e)(1) and (g). Item (e)(2) can be included with (c) and (d). Item (f), the improvement of regulation, cannot be evaluated and no attempt has been made to do so in the analysis.

Two types of installation to secure correction are considered, namely, synchronous condensers and static condensers. Each has its particular field, and in each case the initial cost can be considered as an addition to the line investment. Figs. 1 and 2 show the cost per kva. of the equipment for these two types of correction. It will be noticed that the equipment cost of the static condenser installation at 2,300 volts is less for the installation of smaller capacity, but for big installations the synchronous type costs less.

For voltages other than 2,300 step-up or step-down transformers are generally used with static condensers, and these transformers in general add $3 per kva. to the installation cost, or give about 100 per cent increase. On the other hand, substituting an 11-kv. synchronous condenser for a 4-kv. synchronous condenser adds only about 10 per cent to the installation cost. The cost per kva. for the synchronous condenser installation decreases gradually while the cost for the static condenser becomes constant rather quickly. This results from the high cost of control equipment for the synchronous condenser, and if a static condenser is used every additional kva. means another condenser added to the installation. An annual charge of 15 per cent is used to determine the value of fixed cost per annum.

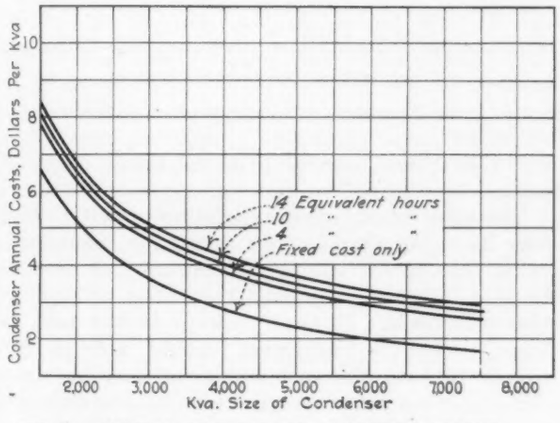


FIG. 1—ANNUAL COST PER KVA. OF FULLY LOADED SYNCHRONOUS CONDENSERS

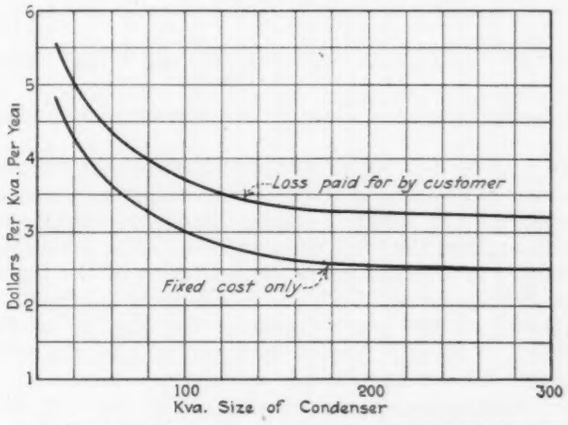


FIG. 2—ANNUAL COSTS OF STATIC CONDENSERS PER KVA.; CONDENSERS ASSUMED ON THE LINE CONTINUALLY

Synchronous condensers have an efficiency of from 95 to 97 per cent, depending upon the size, while static condensers have an efficiency of better than 99.5 per cent for all sizes. Figs. 1 and 2 give the energy loss cost per kva. for various equivalent hours, while Figs. 3 and 4 are of interest in connection with synchronous condensers. For static condensers the loss is a fixed quantity, amounting to 3.33 watts per kva. of condenser capacity. The energy loss cost is computed upon the basis of the demand charge plus a generating charge per kilowatt-hour, the total cost per kilowatt-hour thus varying with the equivalent hours as shown

in Fig. 5. The term "equivalent hours" is defined in the book entitled "Economics of Electrical Distribution," by Reyneau and Seelye, as "the average number of hours per day which it would be necessary for the peak load of the year to continue in order to have the same total energy loss as that actually given by the variable load throughout the year."

A possible saving in line loss is indicated in Fig. 6 in terms of power-factor changes. This saving is of particular importance when cables are used owing to the limited capacity of cables. The use of the condenser on the line increases the total fixed cost, reduces the energy loss and gives a higher output per ampere because of the higher voltages at the receiving end resulting from the high power factor. This same type of saving is identical in the consideration of the transformer energy loss. Its value is relatively unimportant as shown in the chart developed for Fig. 7, as the copper loss is only from 3 to 5 per cent of the total saving. The reduction of transformer losses is of great importance, however, when it is realized that the transformer bank is the neck of the bottle as regards the transmission of a greater kilowatt load for a given installation.

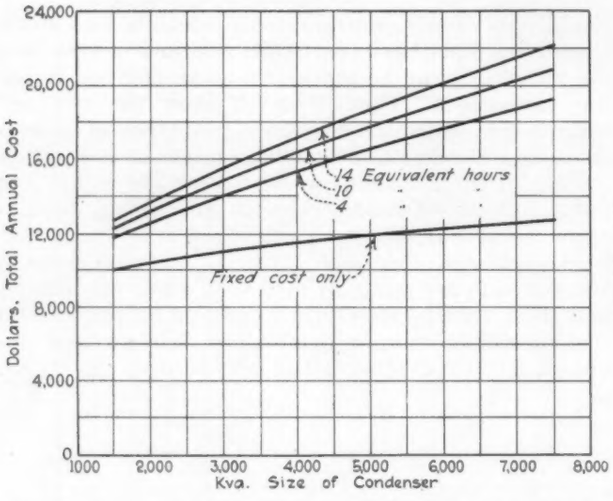


FIG. 3—TOTAL ANNUAL COSTS OF SYNCHRONOUS CONDENSERS

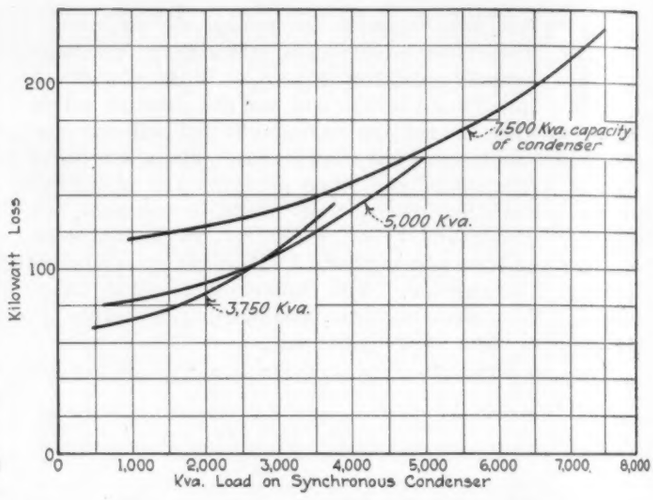


FIG. 4—LOSSES IN SYNCHRONOUS CONDENSERS

The direct result of the installation of corrective equipment is to reduce the reactance kva. load on the generator, and the value of this saving must generally be determined for two conditions—that is, for a new station and for the best operation of a station now in service. Assuming a system without corrective equipment operating at a power factor of 70 per cent, the installation of sufficient corrective equipment to raise the power factor of the generator to 85 per cent would provide a 17.5 per cent increase in generator capacity. If a new station is considered, the cost of the corrective equipments plus their switching and control apparatus must be balanced against the increment cost of larger turbo-generators plus a percentage of this cost to account for the larger boilers, buildings, etc. In the case of an existing station it may be that the station is large enough to carry the reactance kva. and the question is one of the most economical operation, or, on the other hand, the system load condition may have reached a point where additional generator capacity is required to carry the peak. If it is a case of economical operation only, then the corrective equipment cost must be balanced against the saving in losses in the station and line, and the line loss saving will predominate. But if the question becomes one of either installing condensers to lower the peak or adding generators to carry the wattless components, then the comparison reduces to about $12 per kva. for corrective equipment against $100 per kva. for added generators. Even though the ratio of corrective equipment to generator capacity is not one to one, there is ample allowance to show that corrective equipment is more economical than adding additional generator equipment. At the same time the development of system load and the future demand must be taken into consideration.

The value of improved regulation in dollars and cents may be added to the other saving by assuming as its value the cost of additional transmission lines needed to give the same improved regulation without corrective equipment. However, except in the case of long lines, corrective equipment should not be installed simply to save the construction of another transmission line for the reason that a transmission line represents transmission capacity while corrective equipment is more or less an additional substation investment—in other words, a necessary evil.

If the reactance kva. of a transmission line is reduced and the line loss is held constant, the possible load on that line is increased, as is the possible revenue from a given investment. Assuming an average value of 2½ cents per kilowatt-hour for energy sold, the additional revenue obtained by correcting from certain power factors to others was considered on the basis of ten equivalent hours, or ten hours full load per day. This estimate is satisfactory where both power and lighting load is supplied, but where the load is lighting only a value of five equivalent hours is more correct. The increased output per ampere transmitted after the power factor is corrected is due to the reduction of the wattless component and the result of the improved regulation. Moreover, increasing the fixed cost of the line by charging the corrective equipment to the investment increases the load at which the cost per kva. transmitted is a minimum. With no change in the cost of the energy loss the minimum would be raised also. The reduction in the losses, however, tends to pull the minimum cost down to a lower value, as shown in the curves of Fig. 8. For a 10-mile length of line, for example, the minimum point with the corrective equip-

ment is slightly higher than without it, but for a 20-mile line it costs less per kilowatt to transmit a larger block of power with the corrective equipment than it costs to transmit a smaller load without corrective equipment.

Comparison of Synchronous and Static Equipment

The comparison of synchronous and static condensers can be made most easily by listing the advantages and disadvantages of the two types, as follows:

Synchronous Condenser

Advantages	Disadvantages
Can be placed on any voltage up to 13,200 volts direct.	Lower efficiency—from 95 per cent to 97 per cent for different size units.
Lower fixed costs in units above 3,750 kva.	Noisy.
Can be easily adjusted to handle any load within its range.	Has rotating part and therefore requires an oiling system.
Requires about one-sixth as much space (in the larger units) as a static condenser of the same capacity.	May be shut down by a voltage disturbance lasting from one to two seconds.
Voltage of receiving station bus can be controlled by use of condenser equipped with Tirrill regulator.	

Static Condenser

Advantages	Disadvantages
Very high efficiency, better than 99.5 per cent, when working directly at 2,300 volts.	At present built for 2,300 volts only.
Noiseless.	Higher fixed cost in larger units.
No moving parts.	Kva. load is fixed—cannot be easily adjusted to conform to load requirements.
Not affected by voltage disturbances due to short circuits, etc.	Necessity of transformers if to be used on some voltage other than 2,300.
Lower initial cost for small units on 2,300 volts.	

This comparison of the two types of corrective equipment shows that each type has a field of application. A customer with a load of 500 kva., for example, in small and medium-size motors, may not want to substitute synchronous motors for almost foolproof induction motors, and he may not want to bother with a synchronous condenser. If his power contract contains a penalty clause for poor power factor or some reward for high power factor, he will want to maintain his power factor high. For small installations, therefore, the static condenser, owing to its lower cost, very high efficiency and ease of operation, has the field pretty much to itself.

But consider the case where a power company wishes to correct the power factor of a large block of power or needs some means of voltage control whereby the corrective kva. will be large. It is obvious this problem can best be solved by the use of a synchronous machine. Synchronous condensers can be obtained in sizes up to 40,000 kva., and it will be found that the best economy is obtained by the use of a single large unit. Cases may arise, however, where operating conditions or the necessity of always having some capacity on the lines will require two smaller units, so that one will act as "emergency" to the other.

Three methods are given for calculating the saving necessary to justify a corrective installation financially. The first method takes into account the saving in line loss and transformer copper loss, and an example, completely worked out, is included. The results of a number of such calculations are given in Figs. 9 and 10.

Problem.—Find the length of No. 0 22-kv., three-phase, single-circuit line at which the value of the energy losses saved in the line and 22/4-kv. transformers at the receiving end will pay the annual costs on a condenser to correct the power factor from 60 per cent to 100 per cent. Assume a 4,000-kw. load, ten equivalent hours and a 7,500-kva. transformer bank at the receiving end. The condenser is to be located on the 4-kv. bus.

Solution.—Value of energy loss saved per mile of line.

At 4,000 kva. (4,000 kw. at 100 per cent power factor):

$$I = \frac{4{,}000{,}000}{3 \times 12{,}700} = 105 \text{ amp.}$$

At 6,670 kva. (4,000 kw. at 60 per cent power factor):

$$I = \frac{6{,}670{,}000}{3 \times 12{,}700} = 175 \text{ amp.}$$

$$\text{Loss at 105 amp.} = \frac{I^2R \times t \times C_e \times 3 \times 365}{1{,}000} =$$

$$\frac{105 \times 105 \times 0.555 \times 10 \times 0.0097 \times 3 \times 365}{1{,}000} = \$650$$

$$\text{Loss at 175 amp.} = \frac{175 \times 175 \times 0.555 \times 10 \times 0.0097 \times 3 \times 365}{1{,}000} = \$1{,}805$$

Saving = \$1,805 — \$650 = \$1,155.

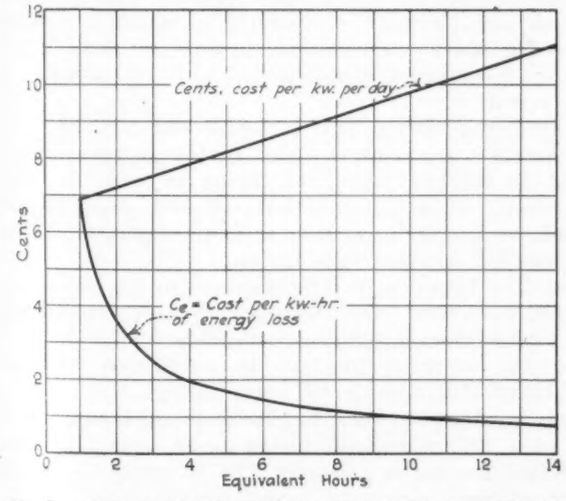


FIG. 5—COST OF TRANSMISSION LINE LOSSES DEPENDS ON THE EQUIVALENT HOURS LINE IS IN USE AND IS NATURALLY HIGHER WHEN USE IS SMALL

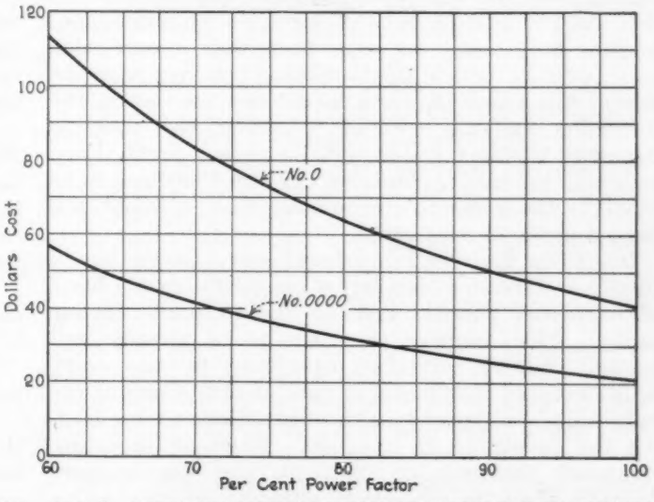


FIG. 6—LINE LOSS COSTS IN TERMS OF POWER-FACTOR CHANGES, BASED ON 22,000 VOLTS, 1,000 KW. LOAD, TEN EQUIVALENT HOURS AND ONE MILE OF LINE

Symbols.—

R = 0.555 per mile for No. 0 wire.
t = equivalent hours = 10.
C_e = cost of energy = \$0.0097 per kilowatt-hour at ten equivalent hours.
3 = number of wires.
365 = days per year.
1,000 = to change watts to kilowatts.

Value of Energy Loss Saved in Transformers:

The actual watts copper loss for various sizes was plotted and a straight line drawn through these points. The problem is of a general nature and the transformer loss should be applicable to any make of transformers; therefore as-

sumed values from this straight line, instead of the actual figures, were used.

Watts loss = 12,400 watts for 2,500-kva., single-phase unit.

Cost per year of copper loss per single-phase, 2,500-kva. unit at ten equivalent hours is $439.

For three units of the bank the cost is 3 × $439 = $1,317.

At 60 per cent power factor the cost is:

$$\left(\frac{6,670}{7,500}\right)^2 \times \$1.317 = \$1,040$$

At 100 per cent power factor the cost is $374.

Saved in transformers, $1,040 — $374 = $666

Reactive kva. in Condenser.—To correct from 60 per cent to 100 per cent, with a 4,000-kw. load, the reactive kva. in the condenser will be 4 × 1,336 = 5,344 kva. A 7,500-kva. condenser will be used.

Condenser Cost.—

Fixed cost of 7,500-kva. condenser:

Cost of building, switching, control equipment, etc.	$60,000
Cost of 7,500-kva., 4-kv. condenser	25,000
Total investment	$85,000

Yearly fixed charge at 15 per cent:

0.15 × $85,000 = $12,750

From Fig. 4, kw. losses in synchronous condensers at various loads, kw. loss at 5,344 kva. load is 171 kw.

Loss = 171 × 10 × 0.0097 × 365 = $6,030

Total yearly condenser cost ($12,750 + $6,030) = $18,780.

Summary.—

Total cost	$18,780
Transformer saving	666
To be saved in line	$18,114

$$\frac{\$18.114}{\$1,155} = \frac{\text{total saving}}{\text{saving per mile}} = 15.7 \text{ miles of line}$$

(at which total saving balances total cost of corrective apparatus).

Other Methods of Computation

In the second method the line loss is assumed to remain constant, the power factor being increased so that the kw. load on the line increases without changing the kva. load. In order to justify a correction on this basis, the additional revenue obtained from the sale of the added kilowatts should pay the cost of the correction and the cost of obtaining and carrying the added business, and in addition show a profit. Even assuming the cost of obtaining the added business to be equal to the corrective equipment cost, a study will show a profit in most cases.

One thing must be remembered when attempting to justify a corrective installation financially on the basis of additional possible revenue due to higher power factor. This assumes the lines to be already well loaded. Adding corrective equipment to help carry additional load may mean, in case of the failure of the equipment, an overload on the transmission lines feeding the substation in question. From an operating viewpoint, therefore, an additional line may be more desirable than the correction, although where the line is long its cost may be greater.

The third method concerns the capital investment in electrical apparatus—generators, transmission lines, distribution substations, etc. If there is a given amount invested in electrical apparatus to carry a certain peak load at a given power factor, then by improving the power factor one can carry the same kw. peak with a lower kva. to be transmitted, and we can assume that the investment needed to carry this "revised" peak will be less, in direct proportion to the kva. on the generators with the original and improved power factors.

To assume an example: Suppose the peak load to be 200,000 kw. at 75 per cent power factor, with an investment of $50,000,000 in the electrical plant. Then by improving the power factor to 85 per cent the kva. on the generators is reduced from 266,700 to 235,300, and it can be assumed that the investment needed to carry the 85 per cent power factor peak is

235,300 ÷ 266,700 × $50,000,000 = $44,100,000,

or a saving of $5,900,000, which can be spent to provide condenser capacity. Since synchronous condenser capacity costs around $12 per kva., this sum will pay for 492,000 kva. of condenser capacity, whereas only 52,000 kva. is needed.

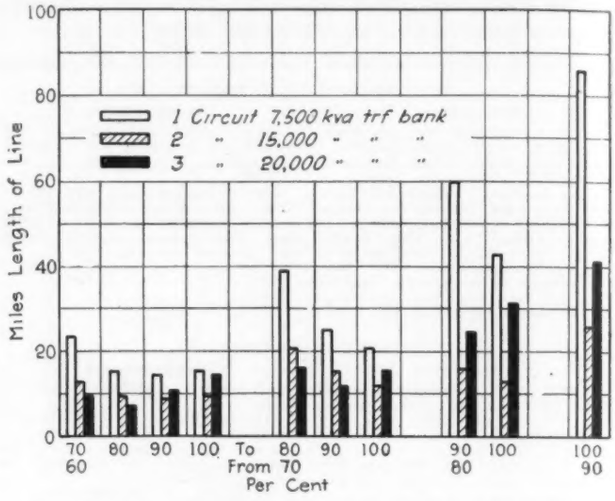


FIG. 7—LINE LENGTHS AT WHICH ENERGY LOSS SAVED BALANCES CORRECTION COSTS

Based on No. 0 circuit, ten equivalent hours, 4,000 kw. load, 22,000 volts.

This method, of course, is not so exact as the first or second, since it may be desirable to maintain certain lines for spare transmission capacity or some other reason; however, it should appeal quite strongly as a last resort.

There is a saving both in losses and capacity, and the question arises as to which saving is more important. In overhead lines, the saving in losses is more important, while in transformers and underground cables the saving in capacity is more important. This decision is based on these facts:

(a) The losses in the transformers in the cases considered were only from 3 per cent to 5 per cent of the line losses—therefore almost negligible.

(b) An overhead line can be overloaded with no possibility of trouble except lower voltage.

(c) A cable in general has twice as much copper for the same normal current rating as an open-wire line, therefore the losses are only half so great as in the overhead line.

(d) Transformers and cables are liable to serious injury if overheated; therefore it is essential to keep the current through them below some safe value.

Location of the Corrective Equipment

The corrective equipment, of course, should be placed as close as possible to the load, thus reducing the wattless current as far back as possible. Static condensers can be placed at the customer's installation, but in general synchronous condensers will be installed in the power company's substation.

In a distribution substation the condenser can be placed on either the high-tension bus or the low-tension

bus. If it be assumed that it will be either 22 kv. or 4 kv., the following analysis should show that it is better to install the condenser on the 4-kv. bus:

Placing the condenser on the 22-kv. bus requires a two-to-one transformer bank to feed the condenser, since it is not built for voltages over 13,200; the cost of the equipment and the cost of the condenser energy loss are both higher at 22 kv. than at 4 kv., and the additional energy loss in the transformers due to poor power factor still exists.

If the condenser is placed on the 4-kv. bus, the two-to-one transformer bank is eliminated, about 28 per cent of the equipment cost and 13 per cent of the condenser energy loss cost are saved, and the copper loss in the station transformers is reduced.

THE MOST ECONOMICAL CORRECTION

In considering the question of how far to correct the power factor, the savings possible, the additional cost and the corrective capacity required, the power-factor rating of the generators, the saving in power-station machinery, and possibly other items of special interest in the case under consideration, must be taken into account.

Energy loss and regulation both decrease as the power factor is bettered. Energy loss is a minimum when the power factor is 100 per cent; regulation is zero at some leading power factor. However, the kva. condenser capacity per percentage of power-factor correction increases as the power factor approaches unity, so that it becomes increasingly expensive to correct to higher power factors.

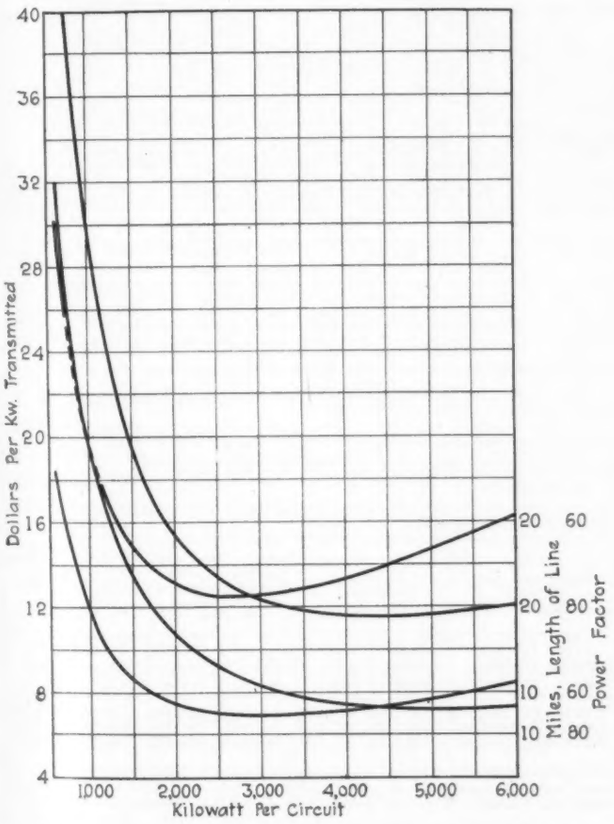


FIG. 8—ANNUAL COST PER KW. TO TRANSMIT AT 22 KV. WITHOUT AND WITH A CONDENSER

Based on No. 0 double-circuit line, ten equivalent hours and a 7,500-kva. synchronous condenser.

Fig. 7 seems to show that the most economical power factor—the one requiring the shortest line to justify a condenser—is around 80 or 90 per cent. Generators are usually rated at between 80 and 90 per cent—85 per cent is a good average figure. Since 85 per cent is an economical point, as a general conclusion, and the generators can handle that load, let a power factor of 85 per cent be set up as something toward which it is desirable to work.

The above remarks apply to a network or a system where the lines are at medium voltage and comparatively short. In a network the load is usually so dense and the number of "loaded" lines so large, comparatively, that the ratio of spare transmission lines to loaded transmission lines will be low—say, around 0.20 or 0.25. Where the transmission is over a long line and at high voltage, the saving in line loss will be a very small item compared with the problem of regulation. Here the condensers will become really a part of the line, used primarily to maintain proper voltage conditions at both ends of it, rather than to correct power factor. Every such case is an individual problem, and no general rule can be laid down for them.

When spending money for equipment intended to save money, it must be remembered that the annual cost of a public utility system contains two items—operating costs and fixed costs. An energy-loss cost is an operating cost—it exists only as long as a load is being carried. A corrective installation requires the investment of capital, and this commits the company to pay annually a sum representing the fixed charges on this capital, whether the equipment is used or not. Therefore, when planning to install corrective apparatus, it is well to make sure that the installation can show a distinct saving and not merely have the correction costs balance the saving effected.

CONCLUSIONS

From the foregoing discussion and the curves presented the following conclusions can be made:

Static condensers are more economical for small installations, while synchronous condensers are cheaper for larger installations.

It is more economical to install one large unit than two smaller ones, although two smaller units may be more desirable in order to be able always to maintain one unit in service.

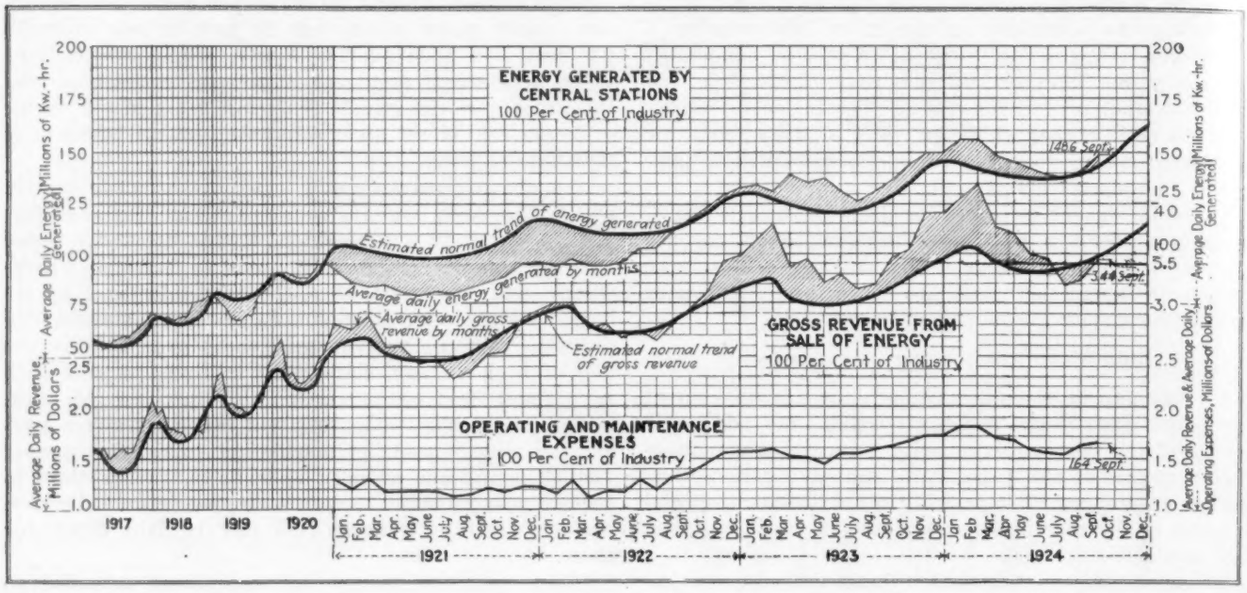
The best power factor to correct to in a network is usually between 80 and 90 per cent. For long transmission lines it will be 100 per cent or some leading power factor, depending upon load and voltage conditions.

The greatest saving in energy loss is in the transmission lines. In the cases considered while preparing this paper the energy loss saved in the transformers did not exceed 5 per cent of the total.

There is a saving both in losses and capacity. As a general statement, the saving in losses is more important in open-wire lines, while the saving in capacity is of greater importance in transformers, cables and generators.

The probable future as well as the present transmission voltage should be considered when deciding whether to place the condenser on the high-tension or low-tension bus. A present 11-kv. system may be changed to 22 kv. before the condenser must be replaced.

September Operations 6.3 per Cent Above Last Year


ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
Estimated normal trend of energy generated
Average daily energy generated by months
1496 Sept.
344 Sept.
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
Average daily gross revenue by months
Estimated normal trend of gross revenue
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
164 Sept.
Average Daily Energy Generated, Millions of Kw.-hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue & Average Daily Operating Expenses, Millions of Dollars
1917 1918 1919 1920 1921 1922 1923 1924

ACTIVITY during September as reported by the central-station industry was 3.8 per cent above the ELECTRICAL WORLD'S estimated point of normal activity in so far as the amount of energy generated was concerned. Revenue received during September, however, was 1.1 per cent below what would have been expected of the industry as a whole. In August the revenue was 7.4 per cent below normal, showing a large financial improvement. The revenue received during September totaled $103,200,000, which was 7.3 per cent above that received during September of last year.

The improved general industrial conditions are reflected in the increased consumption of energy for power purposes. This is the first month since last April in which the amount of energy consumed for power exceeded that of September last year.

TABLE III — OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL POWER PLANTS IN THE UNITED STATES

(100 per Cent of the Industry)

Month	Energy Generated				Fuel Consumption		
	Hydro Plants		Fuel Power Plants				
	Thousands of Kw.-Hr.	Per Cent	Thousands of Kw.-Hr.	Per Cent	Coal (Short Tons)	Oil (Barrels)	Gas (Thousands of Cubic Feet)
*July	1,579,633	37.1	2,676,130	62.9	2,403,265	1,370,199	4,959,046
*Aug	1,492,695	34.0	2,889,452	66.0	2,636,433	1,457,530	5,282,281
*Sept	1,472,370	33.0	2,985,054	67.0	2,639,901	1,351,305	5,789,847

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES

(100 per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly			Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intra-Company Business Including Line Losses, Kw.-Hr.			
	1924 Thousands	1923 Thousands	Per Cent Inc.	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands
July	*4,255,763	4,179,631	1.6	3,433,763	3,371,631	1,032,000	897,000	1,861,763	1,967,131	540,000	507,500	822,000	808,000	728,000	610,000
Aug	*4,382,147	4,316,906	1.7	3,534,647	3,484,406	1,075,000	933,500	1,919,647	2,043,406	540,000	507,500	847,500	832,500	690,000	552,000
Sept	*4,457,424	4,186,492	6.3	3,597,424	3,377,492	1,053,000	915,000	2,014,424	1,964,492	530,000	498,000	860,000	809,000	718,000	631,000

* Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities, minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

TABLE II—CENTRAL-STATION FINANCIAL OPERATIONS FOR THREE MONTHS IN THE UNITED STATES

(100 per Cent of the Industry)

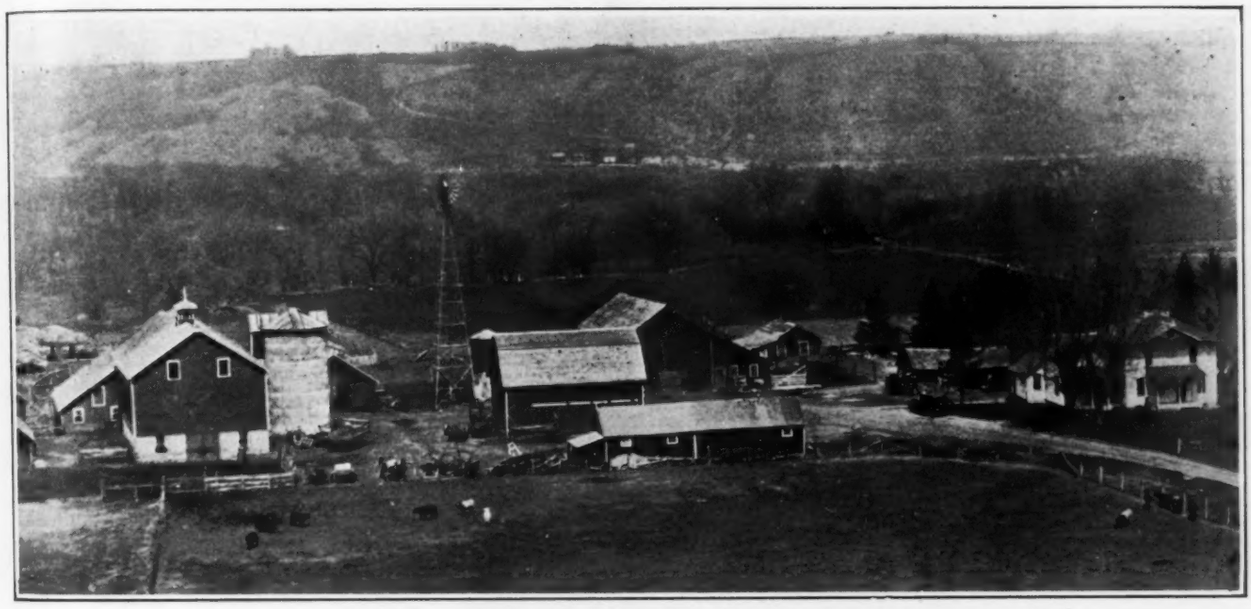
Month	Gross Revenue from Sale of Energy†			Operating and Maintenance Expenses‡			Operating Ratio					
							Steam Plants		Hydro Plants		Combined Steam and Hydro Plants	
	1924 Thousands	1923 Thousands	Per Cent Increase	1924 Thousands	1923 Thousands	Per Cent Increase	1924	1923	1924	1923	1924	1923
July	$99,100	$93,700	5.7	48,800	45,300	7.8	56.1	55.3	28.1	27.9	48.1	46.1
Aug	100,400	94,800	5.8	50,700	47,200	7.4	53.7	55.2	25.2	29.4	51.3	50.3
Sept	103,200	96,200	7.3	49,300	44,900	9.8	50.8	53.2	29.2	27.8	50.1	46.5

† Aggregate gross revenue from actual consumers and sales to other public utilities for resale, involving a certain amount of duplication.
‡ Do not include interest, taxes, depreciation or sinking fund.

Progress in Rural Service Study—I

Twelve States Have Embarked on Economic Investigation — Seven More Are Expected to Organize — What Minnesota Has Already Accomplished—Some Lessons that Apply to All the Commonwealths

By ALLEN M. PERRY
Western Editor ELECTRICAL WORLD



ONE OF THE "AVERAGE" FARMS ON THE RED WING, MINNESOTA, EXPERIMENTAL LINE

TWELVE states are already organized for making a real economic study of the basis on which rural communities can be served with electricity in such a way that it will be profitable to the farmers to use energy extensively and for utility companies to serve them. Seven other states are expected to join the ranks shortly. Of the twelve states already organized, several are well embarked on experimental line investigations and others are contemplating them or are making preliminary investigations. The studies which are being made are quite different in character, as they should be if the various angles of the problems are to be considered, although some duplication in work is necessary as local conditions may make findings in parts of the country inapplicable generally.

The National Committee on Relation of Electricity to Agriculture, of which Dr. E. A. White is the director, has given purpose and direction to the various state movements and has been instrumental in organizing most of them. The committee has recognized that the greatest good can come only from exchange of experiences and has kindly furnished the ELECTRICAL WORLD with the names of the project directors in each state, as well as with much of the other information presented in this article. The states which are organized, the project directors and brief references to the nature of the work follow:

Minnesota. — Eight-farm experimental line near Red Wing (this experimental equipment loaned); Prof. E. A. Stewart, department of agricultural engineering, University of Minnesota, St. Paul.

Alabama.—Ten experimental lines (farmers purchase equipment at regular price); Prof. M. L. Nichols, department of agricultural engineering, Alabama Polytechnic Institute, Auburn, Ala.

Wisconsin.—Experimental line near Ripon (farmers purchase all except experimental equipment); Prof. F. W. Duffee, department of agricultural engineering, University of Wisconsin, Madison.

Iowa.—Experimental line near Garner; Prof. J. B. Davidson, department of agricultural engineering, Iowa State College, Ames.

South Dakota.—Large and prosperous farms on experimental line near Renner; Prof. R. L. Patty, State College of Agriculture, Brookings.

Illinois.—Experimental line; Dean H. W. Mumford, College of Agriculture, University of Illinois, Urbana.

Virginia.—Experimental line; Prof. C. E. Seitz, department of agricultural engineering, Virginia Polytechnic Institute, Blacksburg.

New Hampshire.—Eight separated farms, two of each type; Prof. J. C. Kendall, agricultural experiment station, University of New Hampshire, Durham.

New York.—Prof. H. W. Riley, department of agricultural engineering, Cornell University, Ithaca.

Kansas.—Preliminary survey; Dr. J. T. Jardine, Kansas State Agricultural College, Manhattan.

California.—Outlining investigation; Prof. L. J. Fletcher, department of agricultural engineering, University of California, Davis.

Oregon.—Preliminary survey and possibly experimental line; Prof. H. B. Walker, agricultural experiment station, Oregon State College, Corvallis.

It is expected that Indiana, Washington, Idaho, Colorado, Ohio, Texas and Oklahoma will soon join the ranks of commonwealths seeking to emancipate the farmer by electrifying farm operations.

A survey of all previously existing rural service

lines, involving about 165,000 farmers receiving central-station service, has shown almost without exception that with the present usage of electricity on the farm and present methods of financing, service, application and rates, rural service has not been a paying venture and has even been a loss in some cases. To determine whether rural service can be placed on an economic basis, it has therefore been considered necessary to ascertain the economic uses of electricity in agriculture under the best conditions and to study the value of electricity in improving living conditions on the farm. This problem involves the following inquiries:

1. What field operations can be performed by electrical power?
2. What operations on the farmstead can be performed by electrical power?
3. What operations in the household can be performed by electrical power?
4. What other uses may be made of electrical energy that will increase the production on the farm?
5. What is the best arrangement of equipment on the farm and in the house so that electric power may be used economically to perform the above-mentioned operations and to develop machinery and equipment to carry out these operations?
6. What is the cost of supplying electric service to rural consumers?
7. What method of supplying electric service to rural consumers should be followed?
8. Which of the operations and uses to which electrical energy is applied can be carried out economically, and under what conditions is it economical or uneconomical to perform these operations with electricity?

ELEVATING GRAIN WITH ELECTRIC DRIVE

The success of this activity so far, as well as the assurance of a thorough investigation and logical conclusions, is largely attributable to the co-operative manner in which the problem has been attacked. This is indicated by the representative membership of the national as well as the state committees. For example, the national committee is composed of representatives from the American Farm Bureau of Federation, the National Grange, the National Electric Light Association, individual plant manufacturers, the American Society of Agricultural Engineers, the United States Department of Agriculture, the United States Department of Commerce and the United States Department of the Interior. The state committees are equally well balanced in representation, being composed of leading farmers of the state, some farmers whose homes are served by the rural line, the state agricultural college, the power companies of the state and manufacturers of electrical and farm or barn machinery. In most cases the project directors are representatives of the agricultural college of the state, as it is believed that these men will be recognized as the most unbiased members.

Although the national movement is only a little more than one year old (it was started July 1, 1923), there have been accomplishments besides the organization of the state committees. For example, R. W. Trullinger, United States Department of Agriculture, has made a critical review of "Some Research Features of the Application of Electricity to Agriculture." In this paper Mr. Trullinger presents a very comprehensive survey of the opportunities for house lighting, heating, cooking, food preparation (including meat curing), all mechanical operations requiring power, field and truck crop production, meat curing and water heating, dairying, poultry and egg production, orchard practices, combating insects, hail, drainage and irrigation. G. S. Kinsman of the same department has prepared a "National Farm Power Survey." R. A. Lundquist, United States Department of Commerce, has well toward completion a "Foreign Survey on Uses of Electricity in Agriculture." The National Electric Light Association has completed a survey to determine the number of farms being served by electric light and power companies. Some acomplishments in the various states organized to conduct this investigation locally have been reported from time to time in the ELECTRICAL WORLD.

As an example of what has been acomplished by the state committees and as an indication of what has to be undertaken, the work of the Minnesota committee on the Relation of Electricity to Agriculture will be outlined, since it was the first, or at least among the first, to undertake this work, its first meeting having been held in January, 1923, and construction of its Red Wing experimental rural line started in November, 1923. Considerable of the information which will be presented has been kindly contributed by Prof. E. A. Stewart, department of Agricultural engineering, University of Minnesota, who is project director of the Minnesota committee. Part of it was obtained personally through attendance at committee meetings and inspection of the farms on the experimental line.

FUNDAMENTAL PROBLEMS

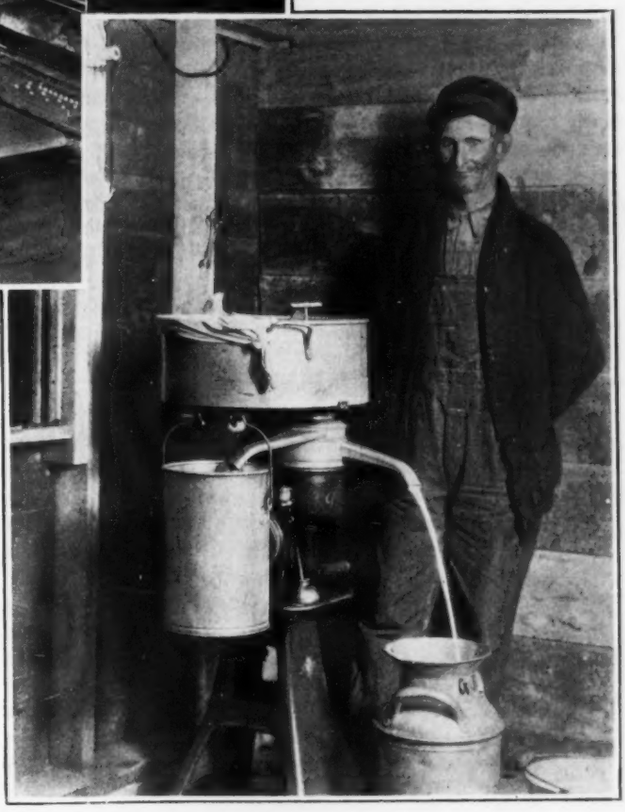
Some of the problems encountered by the Minnesota committee and the method of handling them will be found fundamental in every district. For example, it is necessary to show the farmers how they can use electricity to profitable advantage and what they can

ELECTRIC RANGES AND WASHING MACHINES ARE FAMILIAR CONVENIENCES ON EXPERIMENTAL FARM LINE

afford to do. The rural load must be built to the point where it will be economical for the utilities to serve it. In the study of farm applications it has been the object to unearth as many problems as possible. One of these is adaptation of farm and barn equipment to electric drive, so that electric operation can be carried on most economically and conveniently. Agricultural engineers are investigating the problems of application, and electrical and farm equipment manufacturers have already agreed to co-operate in organizing a plan whereby farm and barn equipment will be made more readily adaptable to electric drive. In the development of farm electrical apparatus manufacturers recognize that they will need the advice of agricultural engineers, and public utilities are rapidly recognizing that they, too, can employ such engineers to good advantage in dealing with farmers, handling applications and so forth, just the same as they now use power-sales engineers to handle industrial problems. As a result agricultural colleges find a new opportunity to serve industry and students by establishing extension courses for training agricultural engineers for these positions. Regardless of who is interested in the problem of farm electrification, it is recognized that the farmers must be "sold right," that rural service must be established on an economic basis, and meanwhile the prevalent opinion that it is impossible to electrify agriculture must be overcome.

It is a generally admitted fact that existing services for rural consumers have not been a paying investment for the power companies that have provided the service. The actual return per customer per month for the small amount of energy used (30 kw.-hr.) has been about $4.50, according to Professor Stewart. Still, the cost of such service on strictly rural lines in the average Middle West farm communities is from about $5 to $9 per customer per month. Therefore it is quite obvious that the problem of providing rural service is an economic one. It is recognized that an economic problem cannot be solved by one group alone but requires the co-operation of all interested groups.

In the Minnesota project it was decided that the rural-experiment electric service lines should be built and maintained by the utility operating in the territory embracing the farms selected for experimentation. The utility company also furnishes meters for measuring the energy used for experimental work and determines the cost of construction, maintenance and operation of the line. All these data will be made



AN ELECTRIC MOTOR SEPARATES THE CREAM FROM THE MILK WHILE THE FARMER RESTS

TABLE I—NATURE OF FARMS ELECTRIFIED

Name	Acres in Farm	Cultivated Area	Leased Area	Cattle	Hogs
Bryan, A. C.	720	360	...	150 Shorthorns	60
Bryan, W. J.	360	225	...	80 Holsteins	40
Cady, W. A.	274	150	165	50 Holsteins	63
Eckblad, C. H.	196	160	...	9 Holsteins	6
Melin, H. I.	257	160	140	60 Herefords 20 Holsteins	40
Miller, F. A.	170	80	...	40 Holsteins	30
Nelson, A.	130	55	...	17 Shorthorns	37
Nelson, H. E. and W. H.	296	150	...	42 Red Polls	50

available to the division of agricultural engineering, University of Minnesota. Other data, such as the maximum demand, the load factor, the power factor, the distribution of loads and so forth, will be determined by the co-operation of the division of agricultural engineering and the utility company. Data on the cost of present sources of farm power and upon the labor required for carrying out the operations on the farms that are to be electrified are also being collected by the division of agricultural engineering. The data will be continued after the electrical equipment is in use. Farmers are asked to keep certain labor records, but most of the data will be obtained by having a division representative right on the job.

The plans for wiring all houses and farmsteads are under the supervision of the agricultural division, which also makes a power survey of all farms that contemplate using electric service. From this survey the division, with the co-operation of the owners, determines what operations on the farm will be electrified and then proceeds to acquire equipment and make arrangements for the proper installation thereof. Part of the equipment to be used will be bought by the farmers. That equipment whose use is considered a doubtful experiment from the economic standpoint will be supplied by outside agencies, the division of agricultural engineering being responsible.

A farm management survey and inventory for the year 1923 on the farms that are selected for power studies will be made by the division of agronomy and farm management. This division will also supply the farmers with books in which the farmers will keep a business record of their operations, with the counsel and advice of the division.

Since the beginning of the Red Wing investigation and up to July 1, 1924, $6,000 has been expended, $1,975 having been contributed by the university, $6,000 by the state committee and $15,000 in loaned equipment by manufacturers.

ONLY AVERAGE FARMS IN INVESTIGATION

The Red Wing line, which is 6.3 miles long, serves only farms of the average type. This is an important feature of the experiment, it being the desire of the committee to ascertain what the average farmer can do rather than what the wealthy farmer can accomplish. An idea of the kind of farms on the experimental line is afforded by Table I.

The farmers listed in this table accepted an invitation to take part in the rural service experiment and have purchased and installed some electrical equipment of their own choice. Other equipment, which has been installed for experimental purposes, has been loaned to the state committee by electrical and farm equipment manufacturers for a period of three years, at the end of which period the equipment may be purchased by the farmers at a depreciated price or may be returned to the manufacturers. The committee has the determination of where the equipment shall be installed and how long it shall be kept there. Table II shows the equipment installed on various farms.

The total connected load, also given in Table II, may be of interest as indicating the amount of load which the committee is attempting to carry on the line and on each transformer, the transformers being each rated at 3 kva. As will be noticed, 20 kw. in installed equipment is provided on the farm of W. J. Bryan, who is using it to the extent of 520 kw.-hr. a month with a maximum demand of 5 kw. In the aggregate, about 131 kw. of connected load is installed on the eight farms with a monthly average consumption amounting to 143 kw.-hr. and an average maximum demand of 4.6 kw.

Attempts have been made to use electricity for the following processes during the past season:

Power Uses.—Elevating grain, cutting ensilage,

TABLE II—CHARACTER OF LOAD AT PRESENT ON RED WING EXPERIMENTAL LINE

Farm	Connecting Load — Watts				Kilowatt-Hours, Consumption	Kilowatt-Hours, Demand	Equipment Installed
	Lighting	Heating	Power	Total			
Bryan, A. C.	2,270	6,100	5,950	14,320	143	4.6	Combination range; two-speed, 5-hp., 1,800-r.p.m., single-phase, repulsion induction motor on skids; hay hoist, washing machine, automatic water pump, sewing-machine motor, vacuum cleaner, electric incubator, electric brooder, ironing machines.
Bryan, W. J.	2,030	9,500	8,575	20,105	520	5.0	15-hp., 1,800-r.p.m., 440-volt motor on skids; electric range, ½-hp. pumping motor, ¼-hp. utility motor, 2-hp. milking-machine motor, vacuum cleaner, ironing machine, 5-hp. motor, deep-well pump, washing machine.
Cady, W. A.	865	7,750	6,475	15,090	75	3.1	Electric range, washing machine, sewing-machine motor; 5-hp., 1,750-r.p.m., single-phase motor on skids; cream-separator motor, milking machine, 15-hp. threshing-machine motor.
Eckblad, C. H.	930	5,030	900	6,860	29	...	Electric frying pan, electric toaster, electric griddle, automatic cistern pump, ironing machine, electric brooder, cream separator, electric incubator.
Melin, B. I.	1,510	11,625	5,200	18,335	169	5.0	Combination range; 3-hp., 1,750-r.p.m. motor, deep-well pump, automatic cistern pump, electric incubator, electric brooder, ironing machine, sewing-machine motor, vacuum cleaner, refrigerator, electric refrigerating machine, washing machine, cream separator.
Miller, F. A.	1,880	7,550	1,725	11,355	114	5.2	Electric range, cream-separator motor, electric incubator, electric brooder, ½-hp., 1,200-r.p.m. milking-machine motor, electric pump jack, sewing-machine motor, washing machine.
Nelson, A. M.	1,340	8,750	3,775	13,865	35	...	Electric range, electric water heater, 3-hp., 1,755-r.p.m. motor on skids, automatic deep-well pump, washing machine, cream separator motor.
Nelson, H. E. & W. H.	1,255	9,500	6,650	17,405	67	5.1	Electric range, washing machine; 5-hp., 1,750-r.p.m. motor (portable); ½-hp. pump motor, automatic cistern pump, deep-well pump, cream separator, refrigerator, electric refrigerating machine, milk warmer.

Total load (eight customers), 117.3 kw.; community motor, 13.3 kw.; grand total 130.6 kw.
Community.— 15-kva. transformer, transformer truck, 15-hp. motor, transmission cable, school washing machine.

grinding feed, cleaning grain, threshing grain, hoisting hay, household uses, milking, mixing concrete, pumping water, refrigeration, sawing wood, separating milk and washing dishes.

Heating and Lighting.—Auxiliary heating, brooding chickens, cooking, incubating chickens, ironing machines, lighting and water heating.

Very soon the committee expects to apply electricity for barn ventilation, corn shredding, corn shelling, poultry-house lighting and operating saws.

Since the largest part of the saving in any particular farm operation is the labor item, an attempt is made to arrive at that item by keeping detailed labor records. These records are of two types—one a monthly record kept by the farmers of such operations as pumping, washing, feed grinding, milking and so forth; the other a detailed daily record showing what each member of the farmers' group did each day for three or four days at different seasons of the year (kept by representatives of the committee). In addition to these records, data are being obtained on elevating grain, pumping water, hatching chickens and so forth. Many preliminary test runs will be made on each piece of equipment that is installed, under all possible conditions, in order to arrive at the best method of performing that particular operation.

Recent Work on the Corona

Difficulties Encountered in Establishing a Law for Practical Lines—Ionization Theory of Corona—Discussion of Recent Papers Presented Before Pacific Coast Convention of A. I. E. E.

By J. B. WHITEHEAD
Professor of Electrical Engineering, Johns Hopkins University

RECENT experiment and discussion on the formation of corona on high-voltage power lines have been of such a character as to throw some doubt upon the accuracy of earlier work and to raise serious question as to the principles and laws which have been used for some time in the design of new lines. For several years past there have been occasional suggestions that our empirical laws, based on observation and experiment, are perhaps not so accurate as supposed. This tendency reached something of a culmination in the group of papers on corona presented at the recent Pacific Coast convention of the American Institute of Electrical Engineers. These papers and the discussion upon them were noteworthy for their absence of definite conclusions and for the difficulty of co-ordinating the results presented by the various authors. It is worth while, therefore, to attempt to take stock of our present knowledge of the occurrence of corona, and particularly to examine in some detail the data presented at Pasadena.

The term "corona" appears to have been used first by Steinmetz in describing the brush discharge from the edge of a sheet-metal electrode placed on the flat surface of a dielectric. Apparently the term was used subsequently to describe any form of high-voltage brush discharge and so was adopted to describe the power loss in the early Telluride experiments of Scott and Mershon (1896), when they found that the line loss was accompanied by a visual discharge around the conductors. These experiments first called attention to the importance of corona, and ever since that time transmission engineers have proceeded on the theory that high-voltage lines should operate well below the corona-forming voltage so as to avoid this loss of power. As the phenomenon was not at all understood, it immediately attracted the attention of a number of investigators, and by 1912 the empirical laws governing the first appearance of corona on smooth wires and under laboratory conditions were quite definite and there was substantial agreement among various observers.

Since that time there has appeared no reason to question the accuracy of these laws. They may be summarized briefly in the statement that for clean round wires there is a simple relation between the diameter of the wire, the pressure and temperature of the air and the potential gradient at the surface of the conductor at which corona will start. Under continuous potentials there are certain differences in the values of the constants for positive and negative potentials, but the form of the law throughout a wide range of pressure and temperature is the same for positive, for negative and for alternating potentials. In the alternating case the potential gradient is that pertaining to the crest of the alternating wave, and if there is any variation of the critical corona gradient with the frequency, it is extremely small, and negligible in the commercial range. These laws and their constants have been studied by several observers, and by the writer using precision methods in the high-voltage circuit, and they are so clear-cut that he has proposed them as the basis of the corona voltmeter for very high voltages, which, owing to its constancy, he has called a standard for high-voltage measurement.

Practice Influences Corona Laws

The questions now arising do not attack these fundamental laws governing the first occurrence of corona on clean wires. It is the application and extension of these laws under the conditions of practice which cause the trouble. Clean, smooth wires do not occur in practice; consequently local brush discharges occur, and instead of being a sharply marked phenomenon, corona begins gradually and probably never in exactly the same way on two wires identical in all other respects. Moreover, as the voltage is increased above the corona-forming point, owing to the same causes the shape of the loss-voltage curve may and generally does vary through a wide range. Fig. 1 shows the variation with the voltage of the current due to corona for a smooth wire, a new cable, a weathered cable and a cable with short metal

points, 6-in. spacing. The marked influence of the surface conditions on both the critical voltage and the equation of the current voltage curve is very evident. Observations and measurements of corona-forming losses have been made almost exclusively on lines in the open, where neither temperature nor pressure nor moisture content can be controlled, where the lines are supported on insulators, and particularly under conditions making it impossible either to examine or to modify the surfaces of the conductors. Further, in the initial stages the loss is not only small but at very low power factor, and all of the available methods of measurement are subject to possible serious errors. No attempt has yet been made to study this important phenomenon under conditions in which all the factors can be controlled.

Most of the measurements have reached to only moderate voltages above the critical value, and in this region it is the surface condition which apparently has led to most of the difficulty in arriving at definite laws and in

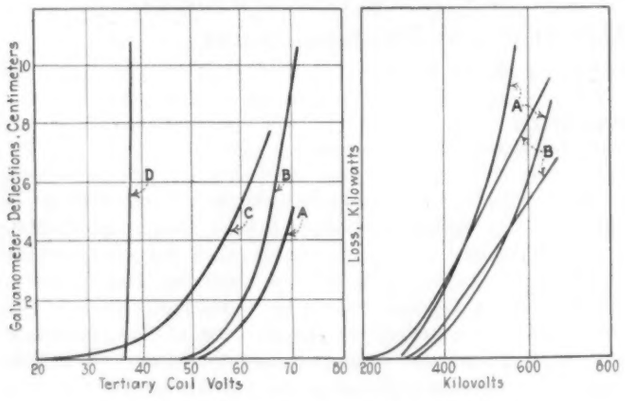


FIG. 1 (LEFT)—TYPICAL CURRENT CURVES OF CORONA DISCHARGE

A—Nineteen-strand ⅜-in. aluminum cable, weathered.
B—Nineteen-strand ⅜-in. aluminum cable, new.
C—Nineteen-strand ⅜-in. aluminum cable, with points.
D—0.188-in. diameter steel rod, nickel-plated.

FIG. 2 (RIGHT)—CORONA LOSS CURVES SHOWING CHARACTERISTIC DEPARTURES FROM QUADRATIC LAW

A—Quadratic law. B—Recent measurements.

comparing the results of different observers. Small irregularities, such as scratches, displaced strands and patches of oxidation, all constitute points of high-potential gradient and lead to brush discharge at much lower voltages than that pertaining to normal corona. It is for reasons of this character that Mershon, one of the earliest observers, failed to evolve a definite law from his notable corona measurements at Niagara in 1907. Other measurements usually on active power lines have been reported from time to time, but it was not until the well-known experiments of the General Electric Company in 1910, under F. W. Peek, Jr., that a definite law backed up by convincing experiments was proposed for the power loss due to corona. The success of this work was due to the fact that the loss curves were pushed up beyond the stage of initial irregular surface discharges, absorbing these discharges in the uniform corona at higher voltage. It is well known that this law states that the loss is proportional to the excess of voltage over the critical corona-forming value and that it increases with the frequency in accordance with a simple relation. In order to take care of the irregularities in the neighborhood of the corona-forming voltage, constants are introduced, based on observations on a number of different types of conductor. Other constants are also given covering extreme weather conditions.

This method of arriving at an empirical law is a very sound one, and the law itself has been taken as a standard for computation ever since it was proposed. There have, however, been a number of other observers, whose results have not been uniformly in accordance with the law as proposed by Peek. In some cases it has been possible to explain the discrepancies as due to the limited range of the observations, these being taken too low on the power-voltage curve, i.e., in the region where irregular brush discharge appears. In other cases the explanation is not so obvious, and it has been necessary to question either the empirical law or somebody's method of measurement.

PACIFIC COAST EXPERIENCE

Coming to the Pasadena papers, there are three of them which presented data on corona losses. One of these described observations on the 110-kv. lines of the Pacific Gas & Electric Company, 200 miles long. The authors are unable to arrive at an empirical relation based on their tests, but simply note that their curves do not follow the quadratic law. This result is apparently satisfactorily explained in the facts that over the length mentioned there were several changes in the spacing of conductors, in their size and make-up, and the range of elevation above sea level was from 83 ft. to 5,200 ft. Observations were taken on single sections and combined sections by reading instruments in the low-tension side of the transformers. Although the figures are very definite and the curves clear, they obviously pertain only to the lines on which they were taken. All of the facts mentioned make it difficult to analyze the results and certainly make it inadvisable to use them as a basis for computation or a reason for loss of confidence in Peek's formula.

A number of loss curves were also presented from the laboratory of Leland Stanford University. Except to call attention to the fact that the losses observed were generally lower than those found by other investigators, no attempt was made by the authors to analyze their results. They emphasized the importance of the brush or point type of discharge on the shape of the power curve, but otherwise than as presenting results at variance with Peek's law they constitute no ground for serious question.

HARDING'S CONTRIBUTION AT PURDUE

The results of Professor Harding of Purdue University, however, must be considered much more seriously. These observations extend to much higher values of voltage than the others, and his curves indicate quite definitely a serious departure from the Peek formula. In fact, the Harding results state quite definitely that the curve plotted between loss and voltage rises much less rapidly than is called for by the quadratic law and in most cases seems to be a straight line after the initial slow rise. These results must be considered to call seriously in question the accuracy of the Peek formula, although it should be noted that within the range of moderately high voltage the differences between the Harding and Peek values are not very great. The degree of the differences is indicated in the curves of Fig. 2. No satisfactory explanation has been offered. Harding's observations are at higher voltages than

those in Peek's original work, but the latter has recently made observations up to 1,000,000 volts for which confirmation of the earlier corona laws is claimed. Perhaps the most striking suggestion in all the discussion is that the influence of the surface irregularities extends all the way to the highest ranges of voltage. If this is so, it not only upsets Peek's law, but means that we could scarcely hope for any law except within very wide limits. Such a condition, however, scarcely appears possible.

It is now generally accepted that corona and brush discharge occur as a phenomenon of secondary ionization or ionization by collision. Under this theory there are always present in the air a small number of free electrons, and these electrons under a high-potential gradient acquire a sufficient velocity to ionize the molecules with which they collide. Once started, the process is rapidly cumulative within indefinitely short periods of time, thus resulting in an apparently instantaneous phenomenon. The starting point is determined by the velocity of the electrons and not by their quantity, thus explaining why corona formation is apparently independent of the presence of other ions, such as those due to ultra-violet light, radio-active substances and to other discharges. The fundamental law of corona-formation has been explained in a fairly satisfactory way on the basis of other proved results of the ionization theory.

NOT HYSTERESIS BUT IONIZATION

It is, therefore, of special interest that Professor Ryan should attempt to explain the process of the loss due to corona as a gaseous hysteresis phenomenon. An extension of ionization theory suggests that the loss due to corona is the result of an intermittent conduction current, carried by groups of charged molecules or ions, resulting from the formation of corona. This is a simple explanation and is roughly in accord with observations of the variation of the losses with frequency. While the explanation of the square of the excess voltage relation has never been worked out on this basis, it does not appear to constitute an objection. Thus it would appear that any new theory should be substantiated by some quite definite evidence. It cannot be said that Professor Ryan makes a good case here. Apparently he is led to his suggestion only by the shape of the power cycles observed when using the Braun cathode tube as a wattmeter for measuring the loss due to corona. These cycles somewhat resemble the hysteresis curves of iron, and their areas are proportional to the corona losses. In fact, the title of the paper is somewhat inappropriate in that the contents do not reveal that the author himself is strongly convinced that the loss arises from causes similar to those underlying magnetic hysteresis. The shape of the power cycles referred to is easily explained on the conduction theory. The voltage electrodes of the Braun tube take up additional charges after corona forms in each cycle. This changes their absolute potential, resulting in a change of calibration. The sides of the power cycle are therefore parallel to the line of symmetry through the center of the figure. In other words, when corona is not present the spot of light passes back and forth over the central line. With the formation of corona, say on a positive half wave, one of the plates takes up a positive charge, thus changing its absolute potential and thus displacing the path to one side or the other, but not changing the slope of the path of the spot. On the next half wave, with opposite sign, the first charge is neutralized and a new charge of opposite sign appears with corresponding change or shift of zero in the opposite direction.

Summarizing briefly, it appears to be impossible from present knowledge either to predict accurately the corona-forming voltage or to state a definite law governing the increase of loss above this voltage. Probably the most important variable element is the surface of the conductor. This naturally suggests the desirability, from this point of view, of a more uniform surface, as offered, for example, by the so-called "lock-wire cable." Further, the corona-loss law, as now generally accepted, has been brought into question in the region in which it has hitherto been supposed to be free from the influence of surface irregularities. However, it should be remembered that the loss curves rise more or less slowly in their initial stages, and fairly wide errors can be made in estimating the corona-forming voltage without serious consequences; and, as already stated, for commercial ranges up to 220 kv. the power values of various observers do not differ widely, although the laws proposed by them may do so, causing wide differences in other ranges. Furthermore, the presence of corona on the line is not the bugaboo that it used to be. Some of the 220-kv. lines are operating intentionally above the corona-forming voltage, and their engineers believe that the presence of corona is a means of protection as a suppressor of high-voltage transients.

The writer's paper on the corona as lightning arrester at Pasadena shows that there is sound theoretical basis for this belief. Thus there would be cases in which it is desired to avoid corona because of the resulting losses, and others in which it would be important to design for a loss which would be protective and yet of not too high value. The importance to the engineer of an accurate knowledge of the conditions of formation of corona, and especially of the loss curves, is thus made evident. It is unfortunately not so evident in which direction to turn for the answer to the present uncertainties. The best plan would be a joint investigation by a group of competent investigators. Control and modification of the form of surface of the conductor is one way of removing uncertainty. Another investigation that may help is that of law or corona loss from clean, smooth conductors. The writer hopes to present some results in this field of investigation in the near future.

President Coolidge on Conservation

ADDRESSING the National Conference on Utilization of Forest Products at its recent convention in Washington, President Coolidge gave succinct expression to his views on the conservation of national resources in the following language: "We hold the resources of our country as a trust. They ought to be used for the benefit of the present generation, but they ought neither to be wasted nor destroyed. The generations to come also have a vested interest in them. They ought to be administered for the benefit of the public. No monopoly should be permitted which would result in profiteering, nor on the other hand should they be indiscriminately bestowed upon those who will unwisely permit them to be dissipated. These great natural resources must be administered for the general welfare

of all the people, both for the present and for the future. There must be both use and restoration. The chief purpose of this conference is to discover policies which will, in the hands of private individuals and of public officers, tend to the further advancement of this already well-defined and securely adopted principle."

Letters from Our Readers

The Mercury-Arc Rectifier Under Short Circuit

To the Editors of the ELECTRICAL WORLD:

I have read the editorial concerning the mercury-arc rectifier printed in your November 22 issue and heartily indorse the statements made there with the exception of the following: "A short circuit is still a troublesome factor . . . is the first of all equipment to go out in case of short circuit." I am forced to take direct issue with you in this latter statement.

Two years ago I witnessed repeated short circuits thrown purposely upon the rectifier sets installed and in operation, at the time, in parallel with other machinery, in the Monbijou substation of the Berne City street-railway system, Berne, Switzerland. These short circuits were made expressly for my benefit to demonstrate the fallacy of my belief that short circuits would be disastrous to the seals and electrodes of the rectifier and would throw the other machinery out of step.

My interest in this matter has been so keen that I have followed carefully the performance of the rectifiers installed on the extensive Chemin de Fer du Midi electrification and quote almost verbatim from a statement by the railway company in reference to this matter that "at Lourdes two sets of rectifiers have been running alternately and permanently for one year and have sustained something like 500 short circuits without any damage. The operation of the rectifiers has been entirely satisfactory, and they require a minimum of maintenance."

As these short circuits occurred during the first acceptance year and the sets were accepted without any qualifications whatsoever, it is convincing proof to me that the mercury-arc rectifier is probably today the most rugged machine either in Europe or this country to withstand successfully and continuously "arc-over" and short-circuit performance.

Lynbrook, N. Y. RICHARD H. WHEELER.

[The statement that the rectifier "is the first of all equipment to go out in case of short circuit" in no way impugns the ruggedness of the equipment. What happens, to quote one operator who has had at least three years' experience in handling rectifiers, is that "they withstand overloads . . . very well, but when short circuits occur . . . . on the line they are the first to fall out of step, followed subsequently by the rotaries, the synchronous motor-generators and finally by the Diesel-engine sets. Parallel operation with these other machines is readily feasible, and any desired load distribution can be arranged. But when a 'short' occurs the rectifier takes the short-circuit load ahead of all other machines and consequently falls out of step." This one operator is here quoted because his statement confirms the conclusions reached after first-hand study of the equipment in Europe by editors of this paper and by several prominent American engineers. The manufacturers themselves confirm these conclusions.

The manufacturers have, as Mr. Wheeler says, succeeded in making rectifiers which are not damaged at all by repeated short circuits. The equipment is extremely rugged. Rectifiers are guaranteed to withstand heavy overloads for a short time, and do so almost daily in service. They handle rapidly changing loads with great effectiveness, and their efficiency is practically a constant, and high, at all loads. In this they resemble a transformer. They are more nearly foolproof, too, than most rotating equipment.

The purpose of the entire editorial was to point out to the American electrical industry that Europe has developed the rectifier until it is a dependable and useful piece of equipment in industrial plants, in light and power substations and in railway substations. It has been freely predicted that it will eventually replace the rotary. But the fact that one of its qualities, namely, its lack of inertia, which helps to give it its pre-eminence, tends also to make it take short-circuit loads away from other equipment with which it may be operating in parallel, and to such an extent as to draw an impossible overload, should not be overlooked. Doubtless some way, if not within, then without the machine, will be found to prevent this, if prevention is desired.

This much is certain—the mercury-arc rectifier has definitely established itself as deserving consideration in much alternating-current-direct-current conversion.—EDITORS.]

Load Transference Between Alternators in Parallel

To the Editors of the ELECTRICAL WORLD:

The question of load transference between alternators in parallel raised by "St. Maurice" in your issue of November 8 and further discussed in two letters of November 22 appears to be entitled to still further comment if the matter is to be clarified.

The first essential in any argument is to agree on the meaning of the terms used, and it is obvious that two distinct meanings have been taken from the term "load" in the first-mentioned case. The practical conception of load is the useful power output in kilowatts, which is independent of the reactive kva. of the system. The latter must be considered, however, when considering the permissible loading of an alternator. Another word quoted by Mr. Waite, viz., "tends," is significant in that it may not result in accomplishment at all, but indicates what might be expected to happen if other dominant influences were not present.

I am not aware of what the author originally quoted had in mind when he suggested the possibility of load adjustment by means of field control, but suggest the following cases as warranting his statement:

Case I. Suppose two alternators of the same rating in all respects to be operating in parallel, but the speed characteristics of the prime movers to be such that one has twice as much change in speed for any given change in load as the other has. Then, if the power factor of the combined load were 70 or 80 per cent, it might be considered advisable to make the alternator with the lower kilowatt load carry a larger part or all of the reactive load demanded of the two units. This would be the result of adjustment of field current.

Case II. Consider two units operating in parallel with the same percentage of speed regulation at full kilowatt load on each, but one of the alternators rated at unity power factor, the other at 80 per cent power factor. It is obvious that the greater part of the reactive load should be carried by the latter machine when the system is operating near full load. The same field settings, however, would probably result in unnecessary losses due to circulating current at light load, and hence adjustment of the field current to obtain more equitable division of the load current would be warranted. W. B. BUCHANAN.

Hydro-Electric Power Commission of Ontario,
Toronto, Canada.

Central Station and Industrial Practice

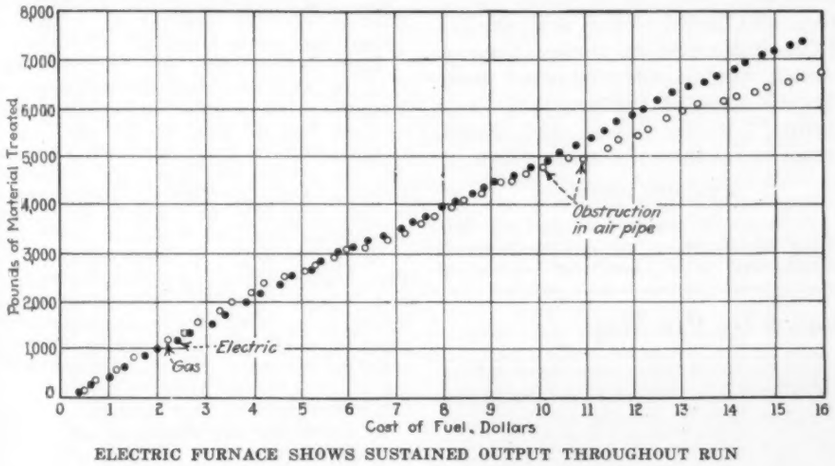
Competitive Tests of Gas and Electric Furnaces

THE Brown & Sharpe Manufacturing Company, Providence, R. I., recently conducted a series of tests lasting about one month on a gas furnace and an electric furnace to determine which would be better suited to its requirements in the heat-treating field. The gas furnace was a type A, No. 30 Surface Combustion, manufactured and installed by the Providence Gas Company. It was rated as having an inside heating space 24 in. deep and 15 in. wide and an entrance 8 in. high and 15 in. wide. The electric furnace was manufactured by C. I. Hayes, Providence, R. I., and had a heating space 21 in. deep, 12 in. wide and 7¾ in. high.

The initial test was to determine whether each furnace would reach and maintain a specified temperature of 1,100 deg. F., uniformly held throughout the oven, and in each case the furnace was loaded with 146 lb. of end mill blanks contained in a sheet-metal box 18 in. long, 10¼ in wide and 5 in. deep. The box was supported in two 1-in. x 1-in. bars, 20 in. long, resting on the furnace hearth, and pyrometers were placed at the left back, right front and center of the heating chamber. The two furnaces met the above requirements and were then left in service for a month to determine the operating costs on regular work.

The accompanying illustration shows the cumulative cost of fuel and electricity during the competitive run from June 30 to July 31 inclusive. A summary of the results is given in the accompanying table.

The average cost of heating was about one-fifth of a mill per pound less with electricity without allowing for the charge of air required with the gas furnace, and the engineers of the Brown & Sharpe company recommended the purchase of several electric furnaces as a result, pointing out that the company had already been using electric furnaces for this kind of work and that there would be no material advantages to be gained from installing gas. With hand control the first cost of the gas furnace was figured at $400 and that of the electric at $440; with automatic control the figures were respectively $750 and $790. It is significant that as the duration of the service test increased, as shown on the chart, the gas furnace gradually began to fall off in the amount of work heated per unit of fuel cost, whereas the electric furnace maintained its output on a straight-line basis throughout the runs.



ELECTRIC FURNACE SHOWS SUSTAINED OUTPUT THROUGHOUT RUN

COMPARISON OF GAS AND ELECTRIC FURNACES FOR HEAT-TREATING

	Gas	Electric
Cost of furnace, hand control	$400.00	$440.00
Cost of installation (estimated equal)	.....	.....
Work treated, lb	6,771	7,378
Gas burned, cu. ft.	20,300	.....
Kilowatt-hours	.....	781
Cost of gas at $0.80 per 1,000 cu. ft.	$16.25	.....
Cost of electricity at $0.02 per kw.-hr.	.....	$15.62
*Cost of fuel per pound of work treated	$0.002398	$0.002117

*This does not include a charge for air that is required with the gas furnace.

Data on Ground Conductors in Conduit

By S. W. Borden
General Manager Groundulet Company, Newark, N. J.

BOTH protective ground conductors and lightning-arrester ground conductors are frequently installed in iron conduit. It is generally understood that a lightning-arrester ground conductor, if installed in an iron conduit, should be bonded to the conduit at both ends, and in some cases public utilities and city inspection departments require protective grounds, when run in conduit, to be bonded thereto.

The general impression is that bonding a conductor to the containing conduit eliminates the choking effect of the conduit, which otherwise is very serious, even on 60-cycle current, to say nothing of the higher frequencies involved in lightning disturbances, etc. In some instances, particularly where flexible conduit or armored cable is used, a separate wire is used to bond (or, more properly, shunt) the conduit. The fact of the matter is that either bonding or shunting a conduit does not appreciably reduce the choking effect in the wire. Shunting a conduit is not in any way beneficial so far as the resistance of the ground wire contained within the conduit is concerned. Bonding the ground wire itself to the conduit simply has the effect of substituting the conduit for the wire, and the benefit derived from doing so depends upon several things.

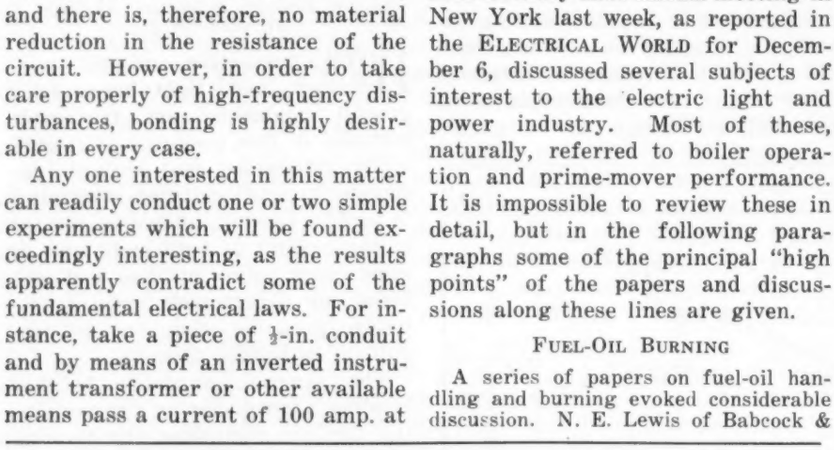
If a No. 8 copper conductor is run in a ½-in. steel conduit and a short-circuit ground current of 250 amp. is passed through the wire, the voltage drop across the conductor, as soon as it becomes hot, will be approximately 70 volts per 100 ft., whereas if the same current be conducted through the conduit itself, the drop across the conduit will be only about 25 volts per 100 ft. It is, therefore, apparent

that by substituting the conduit for the conductor the effective resistance of the circuit will be very greatly reduced. It is interesting to note that under the conditions of current flow stated the resistance of the No. 8 conductor itself, if not contained in conduit, would be about 50 volts per 100 ft.

If the wire is contained in a flexible conduit or steel-armored cable, bonding is of little value so far as low-voltage, short-circuit, 60-cycle currents are concerned, as the resistance of the conduit or armor is greatly in excess of the resistance of the conductor contained within it, and there is, therefore, no material reduction in the resistance of the circuit. However, in order to take care properly of high-frequency disturbances, bonding is highly desirable in every case.

Any one interested in this matter can readily conduct one or two simple experiments which will be found exceedingly interesting, as the results apparently contradict some of the fundamental electrical laws. For instance, take a piece of ½-in. conduit and by means of an inverted instrument transformer or other available means pass a current of 100 amp. at 60 cycles through this conduit and connect a low-reading voltmeter to measure the voltage drop across the conduit, which drop will be found to be approximately 1.25 volts for a 10-ft. length. Now draw a conductor inside of this conduit, the larger the better, and connect it to both ends of the conduit. It will be found that there will be no change in the voltage drop along the conduit and that the copper conductor will take no part of the 100 amp., the full current continuing to flow through the conduit.

Relay Protection Shown by Pin Map



IN ORDER to analyze quickly the operation of the relay protective system in case of trouble and to designate the type of protection used at various points on the system, the Southern California Edison Company uses pin maps as shown above. Pins of different colors are used to denote the type of protection used on each line, transformer or rotating machine at every station operating at 11 kv. or above.

This plan has been used with four different diagrams—*i.e.*, the 220-kv. and 60-kv. systems combined, the 15-kv. system and the 10-kv. system. The diagram of the transmission lines is placed on a soft-pine drawing board, and these boards are kept in cabinet drawers, easily accessible to members of the protection engineering department. The pins used are ⅞ in. long with round enameled heads.

Technical Discussion at A. S. M. E. Meeting

Fuel-Oil and Powdered-Fuel Technique Analyzed—Resuperheating Efficiencies—How to Burn Anthracite Under Boilers—Gas and Oil Prime Movers

THE American Society of Mechanical Engineers, which held its forty-fifth annual meeting in New York last week, as reported in the ELECTRICAL WORLD for December 6, discussed several subjects of interest to the electric light and power industry. Most of these, naturally, referred to boiler operation and prime-mover performance. It is impossible to review these in detail, but in the following paragraphs some of the principal "high points" of the papers and discussions along these lines are given.

FUEL-OIL BURNING

A series of papers on fuel-oil handling and burning evoked considerable discussion. N. E. Lewis of Babcock & Wilcox in his paper dealt largely with the comparative advantages of steam atomization and mechanical burners. The limitation of approximately 200 per cent rating with steam burners has led to the wide adoption of mechanical burners for large stations. The practical limits of fuel consumption per hour per burner are about 1,300 lb. for steam burners and 1,600 lb. for mechanical. Furthermore, more mechanical burners can be installed in a given space than steam burners.

Lieut-Commander H. G. Donald, U. S. N., said that since its first experimental use on capital ships in 1910 the kind of fuel oil used in the navy has passed from a very light oil (Diesel oil) to crudes as heavy as 12 deg. Baumé. Only mechanical atomization is used. As high at 2,000 lb. per hour per burner has been burned.

H. E. Newell, National Board of Fire Underwriters, in discussing "hazards," said that the unit of 40 deg. below flash point for preheating asphaltum base oils for pumping on account of viscosity was sound engineering because conservative. There are no conclusive data on this subject.

In discussing the effects of oil burning on firebrick and furnace linings, Commander Donald said that navy tests show conclusively that insulation of furnace walls shortens firebrick life. Navy boiler walls are thick and have a dead-air space near the exterior, but without insulation. This allows a flow of heat through the brick, keeping it cooler than if there were outside insulation. Thus longer life of brick is assured, even with the same internal furnace temperatures. In some tests, for example, in which the outside walls were cooled by blowing air on them, there had been a change of temperature on the outside of 200 deg., and at the inside surface the variation was so slight as not to be readable. The cooling had the advantage of reducing the penetration of the heat and giving the greater part of the brick better body. Glazing the internal furnace surface was also advised.

In paper on "Hazards of Pulverized-Fuel Systems," Mr. Newell urged separate detached buildings for pulverization, to be used for nothing else. The fluidity of pulverized fuels makes tight bin construction necessary, he pointed out.

R. E. Hall, physical chemist with the United States Bureau of Mines, gave a comprehensive discussion of water treatment for continuous steam production, outlining the necessary conditions for the prevention of scale and cor-

TABLE I—SUMMARY OF PRINCIPAL RESULTS (AVERAGED) OF TESTS ON POWDERED-COAL INSTALLATIONS

Plant	Type and Size of Boiler	Per Cent Rating Developed	Efficiency of Boiler and Superheater, Per Cent	Approximate Heat Value of Coal as Fired, B.t.u.
Cahokia	18,010 sq.ft., horizontal water-tube	.....	83	11,700
River Rouge	26,470-sq.ft., inclined water-tube	150 to 286	80.5	13,300
Rochester Gas & Electric	8,750-sq.ft., inclined water-tube	157 to 199	79.7 (83.5 with economizer)	13,300
Springdale	15,326-sq.ft., horizontal water-tube	214 to 442	79.8	13,300
Penn Salt Co	8,220-sq.ft., horizontal water-tube	101 to 221	82.5	12,600
United Railways, (Providence, R. I.)	12,660-sq.ft., inclined water-tube	175 to 324	81.3 (87.2 with economizer)	13,800
United Railways (Providence, R. I.)	12,660-sq.ft., inclined water-tube	157 to 272	79.8 (86.5 with economizer	11,200 (Mixture of New River and Rhode Island coal)

rosion. The conclusions represent the results of two and a half years of investigation carried out by the Bureau of Mines in co-operation with the Hagan Corporation.

W. E. Browney and G. B. Warren, turbine engineering department, General Electric Company, discussed the increase in thermal efficiency due to resuperheating in steam turbines. They concluded that reheating shows little theoretical advantage. Any practical gain must be found in the better turbine efficiency due to delaying the appearance of moisture. Calculations indicate a decrease of 1.15 per cent in turbine-stage efficiency for each per cent of moisture in the stage. The best point for resuperheating comes at one-fifth to one-sixth the initial pressure and is not necessarily that at which the steam in the turbine loses its superheat. B. N. Broids, consulting engineer with the Superheater Company, said the 1.15 figure would be raised to 1.5 or 2.0 for ordinary commercial conditions because of erosion, dirt, etc. He also questioned the practicability of 750 deg. resuperheating, giving 500 deg. as a more practicable figure. Linn Helander, Westinghouse Electric & Manufacturing Company, said that the high losses of the reheater piping would modify the results too.

Henry Kreisinger, research engineer of the Combustion Engineering Corporation, in a review of recent applications of powdered coal, said that this fuel could never be a complete success until the boiler was built around the furnace. While he expressed a preference for water-cooled walls for high ratings and coal with fusible ash, he said that hollow air-cooled walls were preferable from the viewpoint of safety, because the interspace reduced the chance of back puffs igniting dust in the boiler room. For this reason he thought it might be well to make limited use of hollow walls in connection with water cooling. Mr. Kreisinger closed his paper with data from tests of powdered-fuel installations in seven different plants. From five to thirteen tests were made in each installation. His figures summarizing the results of these tests are shown in the accompanying table covering seven different plants.

The subject of powdered coal called forth considerable discussion on the part of both powdered coal and stoker advocates. A constructive contribution was made by Alfred Iddles, who compared the results obtained with powdered coal at Cahokia and the stoker-fired boilers at Colfax in an effort to locate the gain of 4 to 8 per cent in efficiency usually credited to powdered coal. The boilers were similar in type and size and the furnace volumes practically the same, so that similar performances from the boilers themselves was to be anticipated and the difference in efficiency found in the economy of fuel burning. By plotting the data in curve form it was found that the radiation and unaccounted-for losses were practically the same. This applied also to the losses from water vapor. The dry flue-gas losses were a trifle lower with powdered coal, but the 8 per cent higher heat absorption with the powdered-coal installation was found to be largely in the reduction of combustible material in the ash. This clearly indicated where stoker builders and users should seek improvement.

In a paper on recent developments in the burning of anthracite coal, W. A. Shoudy, Adirondack Power & Light Corporation, and R. C. Denny, Combustion Engineering Corporation, said that a three-arch experimental furnace gave better results than the customary short arch, but with trouble from slagging. A furnace with two arches, one front and one rear, with a restricted gas passage, gave excellent results with low-grade fuel with 30 per cent ash, of which 60 per cent would pass through a $\frac{3}{32}$-in. round-mesh screen. Ratings of 300 per cent were attained, whereas 190 per cent was about the limit in a single-arch furnace.

In a comprehensive paper on gas turbines, Lionel S. Marks of Harvard and M. Danilov, General Electric Company, said that the expectation that the turbine would have a higher efficiency than the reciprocating internal-combustion engine had proved groundless. The gas turbine cannot hope to compete with the engine in small power equipment, and in large units it falls below the efficiency of the large steam turbine.

Dr. C. E. Lucke, in discussing large oil engines, said that widening their scope of utility is mainly a question of reducing weight and thereby first cost. He pointed out that the fixed charges constitute the chief obstacle the oil engine has in its competition with steam. Dr. Lucke then outlined the lines of attack being pursued on this problem.

Other papers having some interest in the electrical power industry had to do with intake and penstock design in hydro-electric plants, and papers by H. A. S. Howarth, L. N. Linsley and Louis Illmer contributed further to knowledge on journal and bearing lubrication.

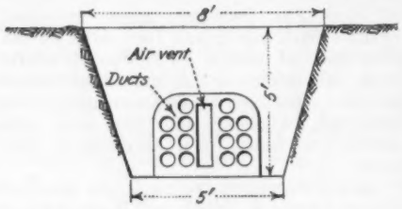
Crane Adapts Itself to Variety of Work

By Thomas E. Bennett
Assistant Distribution Engineer
Dayton Power & Light Company, Dayton, Ohio

THE problem of digging a trench from the new Miller's Ford station of the Dayton Power & Light Company along the east levee of the Great Miami River to Stewart Street, a distance of approximately 7,000 ft., for the purpose of installing an underground duct line, was solved in a most satisfactory and economical manner through the use of a "Universal" crane. The crane, which was recently acquired by the company purposely for the trenching job, is an 8,000-lb. "Universal" crane mounted on a 5-ton White truck and equipped with a 20-ft. boom and a $\frac{1}{2}$-cu.yd. clamshell bucket. The nature of the work consisted in digging approximately 7,000 ft. of trench of an inverted trapezoidal cross-section, installing the duct line and backfilling the trench after the duct line had been installed. During the beginning of the excavation work the clamshell bucket proved unsatisfactory and was replaced with a $\frac{1}{2}$-cu.yd. dragline bucket. This change increased the amount of dirt removed per operation and thus served to increase the progress of the work per day. The excavation work was accomplished with a crew of three men and averaged approximately 200 trench-feet a day. But it is interesting to mention that on the record day, when 230 trench-feet were excavated, the crane operator and the water boy constituted the entire working crew. The duct lines consist of fourteen $3\frac{1}{2}$-in. fiber ducts

embedded in concrete and will be used to carry fourteen 350,000-circ-mil cables, ten of which will operate on 7,000 volts and four on 14,000 volts and which will constitute the main feed to the Third Street and Fourth Street substations in the downtown section of the city.

The process of backfilling the trench presented a problem not encountered during the work of excavation inasmuch as the dragline bucket was required to reach across the trench for the dirt on the opposite side. The soft nature of the soil, which consists mostly of loose dirt and some gravel, prevented the truck from getting within several feet of the edge of the trench, and the 20-ft. boom with its limited radius of operation was found inadequate to do the work satisfactorily. For this reason a 10-ft. extension was added to the 20-ft. boom, so that the resulting 30-ft. boom had a greatly increased radius of operation, especially when a slight swing forward was given to the dragline bucket by the operator. The work of backfilling averaged from 300 trench-feet to 500 trench-feet a day and was completed just thirty-five days after the completion of the concrete work on the duct lines.



DUCT LINES CONSTRUCTED WITH DRAGLINE BUCKET

The crane since its acquisition by the company in April of this year has been used on various odd jobs, such as the loading or moving of unwieldy equipment, at a considerable saving of time and expense. It was placed in operation for the first time on April 26, when through its use the difficult problem of moving three 200-kva., single-phase, 33,000-volt transformers from an old substation site to a new site 400 ft. distant was solved with comparative ease. Owing to the nature of the ground and the load of the transformers — each of which weighed approximately 7,500 lb. complete with oil—it was not deemed advisable to overtax the crane by lifting and then moving the transformers to their new location, so a 5-ton truck was used to do the hauling. It took about four hours to move and place the three transformers in their new location, this being estimated as being about one-third of the time required to do the work by the old block-and-tackle and roller method.

CRANE SUCCESSFULLY USED TO REMOVE HEAVY LOGS AND OTHER OBSTRUCTIONS FROM TRANSMISSION RIGHT-OF-WAY

A more recent adaptation of the crane to odd jobs took place during the construction of the new Dayton-Cincinnati 66,000-volt transmission line, when it was successfully used to remove heavy logs and other obstructions from along the right-of-way. All efforts to remove several large logs by block-and-tackle methods proved futile, and it was finally decided to try the crane on the job.

TWO OF THE VARIED USES TO WHICH TRACK CRANE CAN BE PUT

EXTENDED BOOM WITH DRAGLINE BUCKET

The crane was therefore placed in service, and a steel cable from the dragline drums was run down the 45-deg. incline and attached to the logs. The logs were hauled up the embankment without the least difficulty and then dragged a distance of about 1,500 ft. to a point more accessible for the owner.

The crane has proved its value in the performance of such work. Its mobility makes it an exceedingly serviceable machine, as it can be used on such jobs as digging trenches, which requires considerable time, yet leave its regular job for short periods to do an odd job here and there of the sort described above, and then return to its regular work without undue loss of time. It travels from one job to another at motor-truck speed and can be taken into the garage at night instead of being left out on the job like other draglines and steam shovels. Its flexibility of operation and its mobility greatly increase its efficiency and make it available for various phases of work for which a more cumbersome machine would prove more or less useless.

Eliminating Turbine Runner Pitting

BY FREDERICK KRUG
Superintendent of Power Production Porto Rico Railway, Light & Power Company, San Juan

TROUBLE had been experienced for some years by the pitting of the curb plate on an 1,800-hp. reaction turbine operated by this company. The pitting of the curb plate, which is placed between the scroll case and the quarter turn, occurred on that portion between the end of the runner band and the joint between the curb plate and quarter turn, as shown in Fig. 1.

The water in leaving the runner skips a portion of the curb plate immediately beyond the runner. Because of the fairly high velocity of the water and the vacuum existing at the discharge of the runner the pitting took place on the inside of the curb plate.

The matter was taken up with the turbine manufacturer, who suggested turning down the runner band and the insertion of a wear ring as shown in Fig. 2. By these changes the air pocket which is the cause of the pitting is virtually eliminated and no further trouble is to be expected from this source.

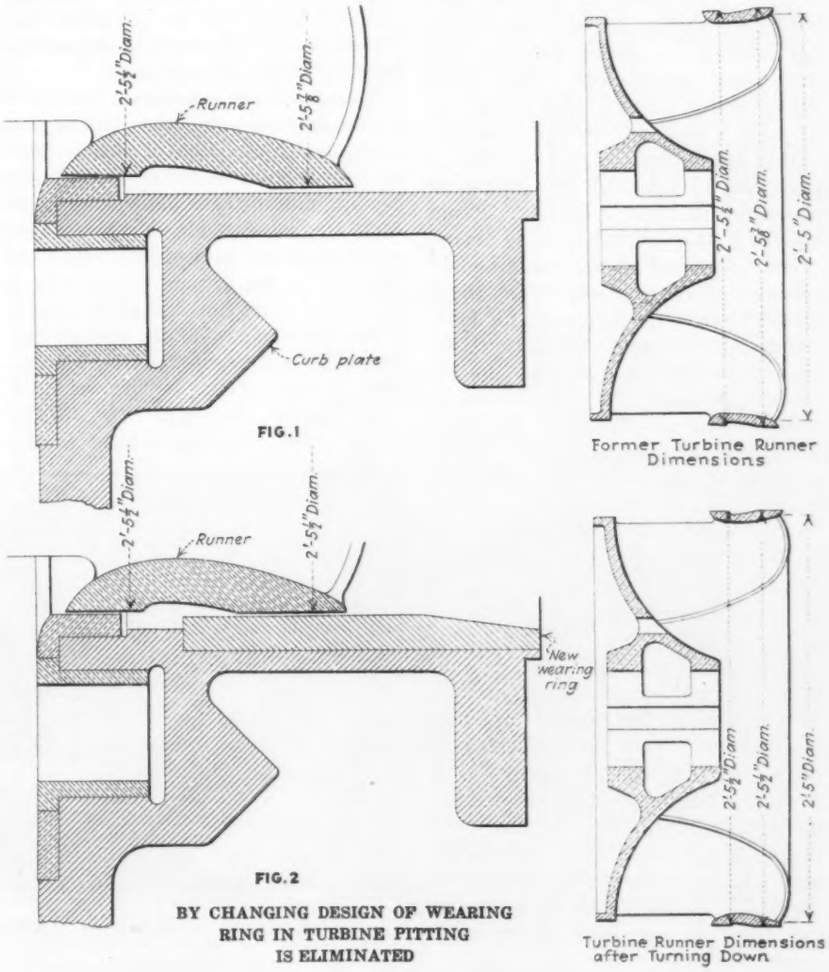


FIG. 1

FIG. 2

BY CHANGING DESIGN OF WEARING RING IN TURBINE PITTING IS ELIMINATED

Simplifying Oil-Burner Control

BY R. H. FORNEY
Superintendent of Power Plant Dallas (Tex.) Power & Light Company

IN SOME oil-burning plants it is the practice to put a valve between the oil-feed line and each burner. With this arrangement the human element is involved in dividing the oil between the burners properly for different loads. Furthermore, there is the disadvantage that so many valves have to be handled in starting.

To eliminate these objections, the Dallas Power & Light Company has inserted 3-in. x $\frac{3}{32}$-in. orifices in the oil feed to each burner. Between these orifices and the main oil feed to the corresponding boiler is one valve which affords the entire control. This arrangement has been found of great advantage in starting up boilers quickly and in adjusting the oil feed to agree with changes in load.

Central Station Business

Selling Utility Service to the Housewife

TO BRING home to the housewife a realization of what good utility service consists, the East St. Louis Light & Power Company has formed a department, in charge of a woman, whose duty it is to make personal calls on all customers to determine whether full benefits of the service are being obtained. The company believes that while economic discussions as to rates, depreciation charges, reserve funds and so forth appeal to business men, they do not serve to impress upon the housewives the value of the service.

For this work women are especially well fitted to represent the company, since the housewife is more willing to talk with another woman than if approached by a man. In systematizing these calls the company's territory is divided into districts. Cards bearing the name and address of each customer are given the interviewer. This card has room for notes of the results of the call, and space is provided for listing appliances in use so that a check can be made of the degree of saturation in the community. From this card, the information is transferred to second sheets contained in a loose-leaf binder, and from these prospect cards are made out for merchandising salesmen. Thus two purposes have been served with the individual, personal call—a creation of cordial relations between the consumer and the company and a determination of appliance saturation for further sales follow-up.

Miss Mabel W. Miller, who has charge of this work for the company, summarizes the advantages of these house-to-house personal calls by a woman as follows:

"Opportunity is afforded of explaining any irregularity of service and removing the cause of any grudge a customer might desire to 'work off' on the company. To stand up against criticism of the company requires tact, courtesy and good humor — qualities which a woman is more likely than a man to combine. It has also been found that fully 85 per cent of the customers are grateful for the information they receive about the company and how the service can be used to best advantage. Then, from the list of appliances used, 'prospect' lists for the salesmen are available. The value of this work lies in the actual intimate contact that can be made with the woman of the household. With her the real keynote in establishing good public relations can be struck."

Electric Cooking in Small Restaurants

Semi-Heavy-Duty Kitchen Equipment in Drug Stores and Lunchrooms Brings New York Edison Company High Return per Kilowatt Connected

INSTALLATION of semi-heavy-duty electric cooking equipment in drug store lunch fountains and small quick-order restaurants is fast being developed into a profitable load by the New York Edison Company. While in the past a number of hotel-type toasters and small electric stoves have been used by drug stores for auxiliary cooking, the recent developments made by the company's heating bureau under the direction of C. N. Lewis call for complete electrification of all cooking apparatus used in these eating places.

Two such installations, one in a waffle shop and the other in the soda fountain of the Hotel Embassy, both of which have been in service for several months, are shown here. In each case the electrical cooking equipment has proved entirely satisfactory to the owners. Not only is this true from an operating standpoint, but the cost of the energy consumed is not considered to be excessive in view of the service received.

The waffle shop, which is situated in the theatrical district on Broadway, has capitalized, of course, upon the fact that all cooking is done electrically. Its principal business is in waffles or toast and coffee, although some short-order cooking of steaks and chops is done. The electrical equipment used for this work, together with the wattage of the heating elements, is shown in the accompanying tabulation. Over a period of thirteen days, when it was thought that the number of customers was running at about the normal rate, a test showed that the average daily consumption of energy was 206 kw.-hr.

While a full year's figures from the operation of this equipment are not yet possible, it can readily be seen that it is a most attractive load for the Edison company. Based on the foregoing average daily consumption for 300 days per year, and taking the full wattage of all appliances totaling 21.6 kw. as the total demand, the energy consumption per kilowatt of connected capacity amounts to 2,861 kw.-hr. per year. The value of this load, without in

WAFFLE SHOP WHICH USES ELECTRIC COOKING EQUIPMENT EXCLUSIVELY

DRUG STORE LUNCH FOUNTAIN IN HOTEL EMBASSY—ALL COOKING EQUIPMENT IS ELECTRICAL

any way considering the diversity factor, may be easily figured.

The use of electrical equipment by the Embassy Hotel drug store was decided upon because for the type of luncheon (soups, sandwiches and coffee) sought by people who rush in at the noon hour, electricity permits of the greatest speed, least danger of fire and lowest radiation of heat into the store. No figures are available for the amount of energy used in this installation, as the equipment is connected through the regular house meter of the hotel. The operation has, however, been entirely satisfactory, and any additional cooking or heating apparatus which may be needed in the future will be electrical.

Many other partial electrical cooking installations are in operation throughout New York City. A popular Broadway cabaret is making a specialty at its midnight performance of waffles cooked electrically. An operator of a chain of restaurants is considering the installation of electrical equipment in twenty of its shops, and a new restaurant to be opened shortly has contracted for a 90-kw. heavy-duty electric cooking installation.

The practical and efficient operation of this equipment for small restaurants opens up wide possibilities for the increased sale of energy by central-station companies, and when it is considered that this class of load earns between $80 and $140 per kilowatt of installed capacity it becomes all the more desirable.

ELECTRIC COOKING EQUIPMENT USED IN MARTIN'S WAFFLE SHOP, NEW YORK CITY

No.	Appliance	Watts
1	Hotpoint Hughes electric range	7,000
1	Hotpoint Hughes electric broiler	5,000
1	Hotpoint Hughes electric oven	3,000
6	Hotpoint waffle irons, 600 watts each	3,600
6	Hotpoint percolators, 500 watts each	3,000
	Total wattage	21,600

ELECTRIC COOKING EQUIPMENT IN DRUG STORE OF HOTEL EMBASSY

No.	Appliance	Watts
1	5-gal. Barth water urn	2,000
1	3-gal. Barth coffee urn	1,500
1	36-slice Barth electric toaster	4,600
1	Four-compartment Barth steam table	2,000
1	Two-baker waffle unit	1,200
	Total wattage	11,300

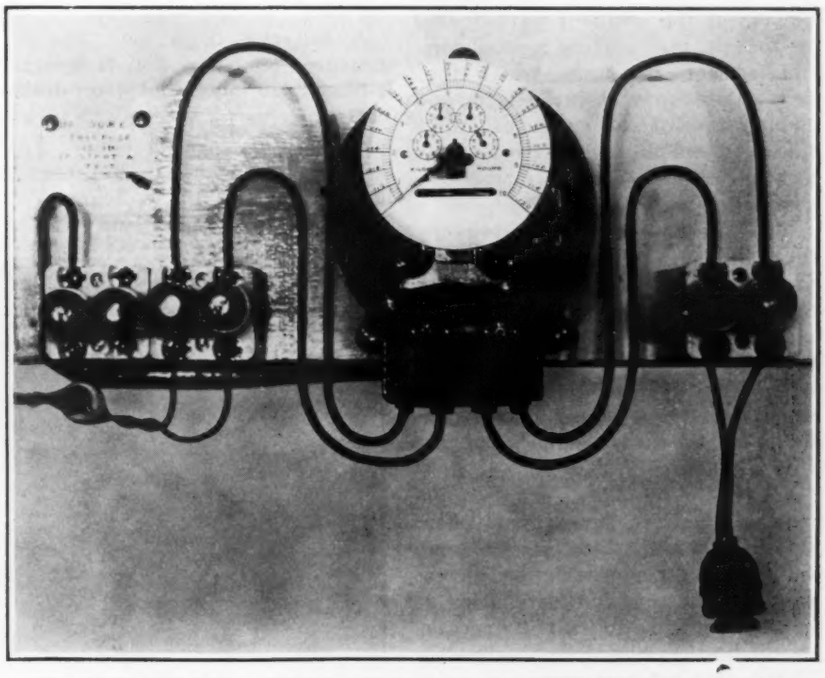
Portable Meter Shows Cost of Using Appliances

TO AID salesmen in demonstrating to customers the cost of operating electrical appliances a form of cents-per-hour meter as illustrated here is used in the Kentucky Utilities Company's Pineville showroom.

The meter used is a Westinghouse type RO watt-hour demand meter, style 19031 two-wire, 5 amp., 100 volts, 60 cycles, fifteen-minute time interval, full scale on demand dial, 1-kw. dial graduated in 100 minor divisions and ten major divisions, which makes it easy to compute any rate per kilowatt-hour. This type of meter was selected because it can be used to indicate the watts that the appliance consumes by detaching the time element, and it also indicates the cost per kilowatt-hour at the same time, this being computed on the outer circle of the demand dial at the net rate per kilowatt-hour.

The meter is mounted on a board with an entrance switch, fuse block and snap switch. The latter is for "shorting" out the current coil to prevent the inrush of current from possibly damaging the indicating mechanism and also to allow heating devices time to take the minimum amount of current.

The meter was made up mostly for use in the showroom, but it can be converted to a fifteen-minute integrating demand meter and used in the customer's home to determine the demand and kilowatt-hours consumed for a period of time.



DEMAND METER WITH CENTS-PER-HOUR DIAL SHOWS COST OF USING APPLIANCES

"Daylight" Feature Sells 11,449 Kitchen Units

A SOMEWHAT different angle in the sale of better lighting to the home has been developed by the Utah Power & Light Company of Salt Lake City. It is an expansion of the better lighting idea to play up the use of daylight lamps in kitchen units.

In a campaign recently conducted by the company a kitchen lighting unit was offered for $6.50, payable 75 cents a month. The campaign opened with large newspaper advertisements and a broadside mailed to customers. Considerable space was used during the course of the campaign to keep the company's offer before the public. In all the advertisements large illustrations portrayed the contrast between kitchen lighting with a drop light and the company's "daylight" kitchen. "Have you ever used cayenne for cinnamon?" queried one caption and added, "Better kitchen lights prevent mistakes." Throughout the campaign the slogan, "Daylight your kitchen," was capitalized.

The sales quota set for the campaign was 6,000 units to be sold in one month. A total of 11,449 were sold. This covered 17.5 per cent of the customers of the company.

Personal calls were made by salesmen who explained the advantages of better home lighting and assisted housewives in lighting problems in other parts of their homes than the kitchen. The campaign was thus made generally educational. All employees of the company participated in the sale, each getting a small commission for any units which they sold. Consequently enthusiasm and co-operation of the entire organization was enlisted, which resulted in a total sale of almost double the quota.

The increase in use of energy by these kitchen lighting units over the drop-cord lamps and obsolete fixtures displaced will, in the aggregate, earn a material addition to the revenue from residential customers. If each unit installed uses only 25 cents' worth more energy per month during the six winter months of the year, the entire 11,449 will add $17,173.50 to the company's gross annual income. This is an extremely conservative estimate of the earning value of this business as many companies figure that the installation of kitchen lighting units will increase the domestic revenue approximately $3 per year per customer.

Clicquot Club
GINGER ALE
World's Largest Seller
A PARAMOUNT PRODUCTION BY CECIL B. DE MILLE
THE TEN COMMANDMENTS
ACROSS THE STREET GEO. M. COHAN THEATRE TWICE DAILY

ELECTRIC SIGN WITH TOTAL CONNECTED LOAD OF 263.75 KW.

Single Electric Sign Uses 44,300 Kw.-Hr. Monthly

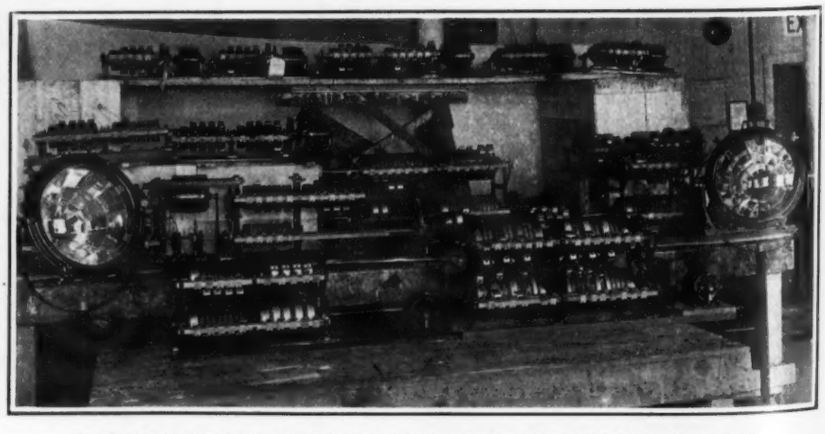
PROMOTION of electric signs as a means of increasing revenue was one of the first organized commercial efforts of the central-station industry. How this source of new business has grown in importance is strikingly illustrated by some interesting figures giving the size, number of lamps, connected load and energy consumption of the "Clicquot Club" ginger-ale sign overlooking Times Square in New York City. The sign is connected to the lines of the United Electric Light & Power Company, and in beauty and advertising effect it is a fine compliment to the ingenuity of the sign maker's art.

A full city block long, the sign measures 58 ft. by 260 ft. over all. It has 14,670 individual lamps divided in wattage as follows: 6,449 10-watt lamps, 1,017 15-watt lamps, 7,200 25-watt lamps and four 1,000-watt lamps.

The total connected load is 263.75 kw., and the action of the sign is effected by means of twenty-nine motor-driven flasher devices each carrying from six to ten contact points. These flashers, motors, automatic switches and timing devices are housed in a special structure as large as a trolley car beneath the skeleton framework. More than 21 miles of wire were used to connect the lamps and flashers, and seven hundred pounds of solder were required in the construction.

The lighting and operation of the sign consumes 200 kw.-hr. of energy per hour, nearly four times as much as any other electric sign on record. Since its erection last summer the recorded consumption of energy has been in kilowatt-hours: June, 24,400; July, 26,300; August, 33,100; September, 35,900; October, 44,300.

This sign was built and erected by the O. J. Gude Company, and it has the distinction of being not only the heaviest user of energy but also the largest spectacular electric sign ever built.



PART OF FLASHER EQUIPMENT WHICH OPERATES CLICQUOT CLUB SIGN

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

The Tirso Dam, Sardinia. — The Santa Chiara di Ula Dam on the Tirso River, recently completed, is designed to serve the triple purpose of flood control, irrigation and power production. It is said to be the highest and most important example of a multiple-arch dam to be built, consisting of seventeen arches, of a total length from center to center of the end piers of 509 ft. and a maximum height of 228 ft. from the lowest foundation level to the roadway along the top. The power station is within the dam and is to be equipped with two twin-runner inward-flow horizontal turbines, each of 6,000 b.-hp., coupled to 5,000-volt, three-phase generators with direct-connected exciters. Later two similar 9,000-hp. units will be installed. The available annual output is estimated at 50,000,000 kw.-hr. The head will fluctuate between wide limits, the average being about 150 ft. —*Engineering (England)*, Nov. 7, 1924.

New Crawfordsville Unit Shows High Economy.—The article gives data secured during the acceptance test of a 3,750-kva. turbo-generator. Plant details are described and illustrated. — *Power Plant Engineering*, Nov. 15, 1924.

Applications of Hydro - Electric Power.—T. J. MIRCHANDANI.—The first part of this article consists of a summary, chiefly qualitative, of the advantages of hydraulic as against steam stations. The second part relates to the application of hydro-electric power to railway electrification. The necessity of a low cost for power is pointed out, if electrification is to pay, as is the circumstance that all large trunk-line electrification systems draw their power from hydro-electric stations. Instances are cited in the United States, Switzerland, France and other countries. To show the possibilities of automatic operation of substations and of small hydraulic plants feeding into a railway supply system costs are worked out for two assumed cases.—*World Power (England)*, November, 1924.

Generation, Switching, Control and Protection

Automatic Safety Switches.—C. MEYER.—On board ships, where in a limited floor space a maximum of electric generating machines must be installed, all generators are usually operated at their maximum capacity. A failure of one generator will therefore cause such a heavy overload upon the remaining machines that their breakdown will be threatened. The author has devised a special automatic circuit breaker in combination with an auxiliary switch, which in case of tripping due to failure or excessive overload removes part of the load from the buses, thereby preventing a prohibitive overload on the other generators. The feeders from the buses are grouped into those which cannot stand interruption, like feed-water pumps, rudder machines, cooling water pumps for prime movers, etc., and those where a temporary interruption is of no great importance, as ventilation, heating, illuminating, etc. A detailed description of these new switches is given, and diagrams of their use on several modern ocean liners are shown.—*Siemens Zeitschrift*, October, 1924.

Shape of Pole Shoe Required to Produce a Sinusoidal Distribution of Air-Gap Flux Density.—B. HAGUE.—This paper presents a theoretical investigation of the method of producing a sine wave emf. by so adjusting the reluctance of the air gap that the flux distribution is sinusoidal. The analysis is made for external and internal poles, corresponding to rotating armature and field respectively. A smooth-core armature is assumed, or one in which the slots have been closed by means of magnetic wedges, as in a wave-form standard. Finally, a numerical example is given illustrating the theory.—*Journal of the Institution of Electrical Engineers (England)*, November, 1924.

Transmission, Substations and Distribution

Heating of Large Steel-Cored Aluminum Conductors.—R. J. C. WOOD.—Results of tests are analyzed graphically and equations deduced. For abstract see report of Pacific Coast convention, ELECTRICAL WORLD, November 1.—*A. I. E. E. Journal*, November, 1924.

Equivalent Single-Phase Networks for Calculating Short-Circuit Currents Due to Grounds on Three-Phase, Star-Grounded Systems.—ROY A. SHETZLINE.—For an abstract of this paper, presented at the Chicago convention of the A. I. E. E., see the ELECTRICAL WORLD of July 5. The treatment is mathematical, with numerous diagrams and an illustrative numerical example. —*A. I. E. E. Journal*, November, 1924.

Study of Underground Distribution Systems for the City of New Orleans. —W. R. BULLARD.—For a summary of this paper and the discussion on it see the report of the Chicago convention in the ELECTRICAL WORLD of July 5. — *A. I. E. E. Journal*, November, 1924.

Direct Method of Calculation of Capacitance of Conductors. — H. B. DWIGHT.—In this paper, to which reference was made in the ELECTRICAL WORLD of July 5 in its report of the Chicago convention, a "direct method" of calculation of capacitance is described for multi-conductor cables with round conductors, which gives accurate expressions for the irregular distribution of electricity on the conductors and for the value of capacitance. Formulas and examples are given for finite wire and infinitesimal wire, single-phase overhead line, two conductors and sheath, etc. — *A. I. E. E. Journal*, November, 1924.

Units, Measurements and Instruments

Directions for the Study of Electrical Insulating Varnishes, Paints and Enamel Paints.—This is the report of the British Electrical and Allied Industries Research Association, giving specifications for the testing of substances indicated above. Properties specifically covered are specific gravity, viscosity, flash and fire points, drying (in considerable details), electric strength waterproof tests, aging, effects of acids and alkalies, and effect of oil. Tests for the effect of varnish upon copper, of corona discharge, of producer gas and for the permanence of colored enamels are reported as being under consideration. The specifications are preceded by definitions of terms used, e.g., oil varnish, lacquer, enamel paint, bituminous enamel, etc.—*Journal of the Institution of Electrical Engineers (England)*, November, 1924.

Measurement of Capacity by Analogy.—WILLIAM CRAMP. — In the case of condensers for use on power systems the geometrically simple shape of the dielectric and the amount of energy stored make it easy both to compute the capacitance mathematically and to measure it. But in the case of wireless telegraphy not only are the condensers often of a capacitance measured in micro-microfarads, but also, on account of using radiating condensers, the forms cannot be limited to those which admit of calculation. The purpose of the present article is to develop a method of measuring by analogy, applicable to all condensers, even those of the most irregular form, and requiring very simple equipment. The mathematical theory, obtainable accuracy, limitations and construction of standards are discussed with the aid of tables and diagrams.—*World Power*, November, 1924.

Motors and Control

Economics of Power Consumption.—D. J. BOLTON.—The selection of a motor is usually determined by the smallest size, and consequently the one involving the least initial expense, for the estimated power output, either for present needs or with an allowance for an anticipated increase in the demand. The author points out that economic considerations may justify the purchase of a materially larger-framed machine to be operated below its rating not merely as to output but also as to voltage rating. He reasons that such operation means a lower working density of both iron and copper and up to a certain point smaller internal losses. To show the method, an example is worked out graphically, based on cost quotations and the makers' figures for efficiency, with stated assumptions as to useful life and a given rate for energy, from which it appears that under the specified conditions, instead of getting a ½-hp. motor, it would in the long run be cheaper to get one of from ⅛ hp. to ¼ hp. and operate the material at a reduced density. Another case is worked out for a larger size. The choice will necessarily vary with the cost of energy and the number of hours of operation per year. Finally empirical equations are deduced, to be used

if desired, instead of the graphical method.—*Journal of the Institution of Electrical Engineers (England)*, November, 1924.

Heat Applications and Material Handling

Electromechanic Supply Machinery for Blast Furnaces.—J. STRUDTHOFF.—In a large German blast-furnace plant, operating five furnaces in one row, a modern conveyor installation, supplying all five furnaces, has been built which supersedes the previous individual steam drives. Instead of the former inclined rails to the top of each furnace, all five are now arranged under a common steel structure, which carries on top an operating room from which an elaborate hoisting apparatus is controlled. The high-voltage three-phase supply drives two sets of motor-generators, the direct-current side of which feeds the various motors of the hoist in Leonard connection. A number of safety devices prevent faulty operation or collisions between ore and fuel containers which run simultaneously. The very complex wiring diagram of the entire installation is given with a description of its operation.—*Siemens Zeitschrift*, September, 1924.

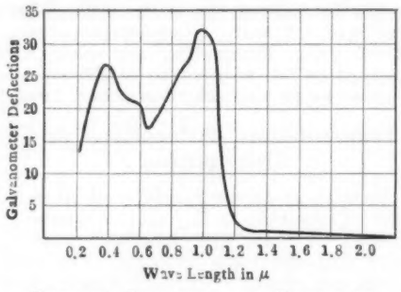
Electric Iron Smelting and the Resistance of Coke and Charcoal.—A note on a recent report of a committee appointed by the Swiss government to inquire into the country's resources of iron and manganese and to report upon their utilization in the various industries.—*Engineering (England)*, Nov. 7, 1924.

Traction

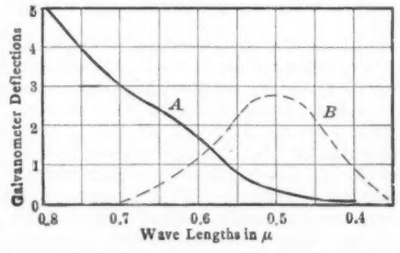
Discussion of Mercury-Arc Rectifiers.—An elaborate paper on large mercury-arc rectifiers was recently presented by Mr. Giroz before the French Institute of Electrical Engineers, and the present article contains the discussions contributed. Mr. Leblanc calls attention to the fact that in England the glass-bulb rectifier has found very large use in sizes up to 200 amp. He estimates that a total of 12,000 kw. is installed in England in this type of rectifier. There are in operation a number of street-railway substations, in which eight parallel units of 150 amp. each are installed. In substations for lighting supply, such groups of rectifiers feed three-wire lines of 440/220 volts, with special 440-volt rectifiers connected to the outside lines during peak loads. The connection and operation are usually fully automatic, requiring on an average only three seconds to start and connect one rectifier unit to the buses. Mr. Bunet discusses the wavy character of the rectified direct current and points to the possible telephonic disturbances caused by such circuits. He also mentions that such direct-current-feeding motors have been known to cause heating due to parasitic inductive flux. Mr. Giroz shows that this influence is extremely small for properly rectified currents, such as are derived from a six-phase arrangement. The same critic doubts Giroz's statement that the average efficiency of a rectifier will be 10 per cent better than that of a medium-size transformer and rotary set. This is refuted by Giroz, who states that the efficiency of a rotary between 500 kw. and 1,000 kw. is not higher than 85 per cent, while a similar rectifier reaches readily up to 95 per cent, a fact which has been borne out by many plants. Mr. Demontvinier gives a theoretical explanation of the influence of the number of phases with which a transformer feeds the rectifier, particularly in view of the voltage drop on the direct-current lines. He comes to the conclusion that a six-phase arrangement with properly dimensioned inductance coils gives the most satisfactory arrangement. However, it is generally conceded that much systematic research work has yet to be done in this respect.—*Bulletin de la Société Française des Electriciens*, Vol. 4, No. 36.

Electrophysics, Electrochemistry and Batteries

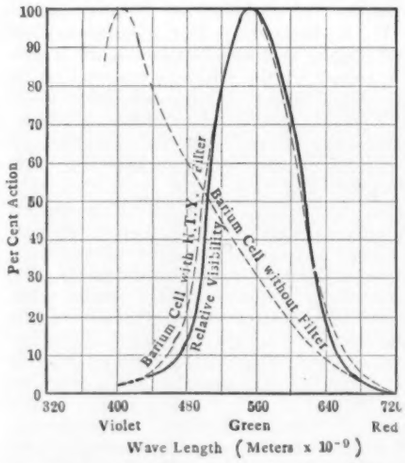
Photo-Electric Cells.—C. F. ELWELL. Several types of high-vacuum cells developed by T. W. Case are here described. In the first, the thalofide cell, the active photo-electric material is composed of thallium, oxygen and sulphur, fused on a ¾-in. quartz disk. In the second cell described the sensitive deposit consists of metallic strontium on a plate 1⅛ in. by 5⅛ in. in a glass tube about 2 in. in diameter and 9 in. long. The third type uses a deposit of barium on a film of aluminum on a part of the inner wall of the glass bulb. The action of this cell is due to pure electron emission and is practically instantaneous in response and recovery. A suggested method of using these various cells is in connection with electron tubes as relays, the cell being placed in the grid-filament circuit and the potentials so balanced that a slight change in its resistance causes a large change in the plate current.—*Electrician (England)*, Nov. 7, 1924.



SPECTRAL SENSITIVITY OF THALOFIDE



SPECTRAL SENSITIVITY OF STRONTIUM CELL



SPECTRAL SENSITIVITY OF BARIUM CELL

Heaviside's Operators in Engineering and Physics.—E. J. BERG.—This is a long mathematical paper embodying the author's lectures at the Moore School of Electrical Engineering in the spring of 1924. After explaining the significance of the symbol p and its reciprocal, he compares the equations of a number of simple circuits according to Heaviside's notation and as usually written. The method is then applied to a variety of more complicated cases encountered in practice, involving concentrated as well as distributed line constants.—*Journal of the Franklin Institute*, November, 1924.

Telegraphy, Telephony, Radio and Signals

Obtaining Steady High-Voltage Direct Current from a Thermionic Rectifier Without a Filter.—F. W. MAXSTADT.—When the usual voltage waves produced by a polyphase generator are rectified by a kenotron, the resulting unidirectional voltage has a "ripple" or alternating component. If, however, each phase of a Y-connected machine can be made to generate a triangular wave the resultant terminal voltage wave-form will be flat-topped; in that case rectification should give a perfectly constant voltage, without ripples. The paper describes a special generator designed for this purpose and shows by means of oscillograms that the fluctuations were actually much smaller than when a sine wave was used. Rectification of 100,000 volts and 50 milliamperes was accomplished, with a maximum variation of direct current of 2.8 per cent, as against 10.5 per cent with a sine wave.—*A. I. E. E. Journal*, November, 1924.

Electrical Resonance.—E. AMBROSE and P. B. FROST.—The investigation described in this article was prompted by the apparently erratic behavior of some apparatus used to demonstrate voltage resonance. It is shown experimentally that when iron-cored inductance is used its varying permeability, depending as it does on the instantaneous magnitude of the current and even to some extent on its previous history, makes resonance possible over a much wider range of frequencies than might be anticipated. This could account for occasional breakdowns which are attributed to surges. Curves are given and conditions described under which it was possible to start a large resonating current, as well as to stop it, though the circuit was still closed.—*Electrician (England)*, Nov. 7, 1924.

New Books

Practical Radio

By James A. Moyer and John F. Wostrel. New York: McGraw-Hill Company, Inc. 249 pages, 169 illustrations.

The author presents the fundamental principles of radio as an electrical science clearly and simply, so that any person of average training should be able to understand and apply them. He describes the best kind of sets, showing how to buy, operate, list, repair and build them. Complete working drawings are given for the construction of eight typical receiving sets, namely, crystal receiver, single-tube regenerative receiver, two-storage audio-frequency amplifier, two-stage radio-frequency amplifier, single-tube reflex and four-high reflex receivers (both with crystal detectors), three-tube neutrodyne receiver and six-tube superheterodyne. The book also contains up-to-date information on the control of static, atmospheric and direction effects, radio maps, batteries, transformers, vacuum tubes, antennas and ground wires.

Electrical Wiring

By Albert A. Schuhler. New York: McGraw-Hill Book Company, Inc. 361 pages, 305 illustrations. Price, $2.50.

This book is primarily a textbook of applied electricity for vocational and trade schools. The author has divided the various branches of electric wiring into units. Each unit forms the subject matter of a systematic course and is subdivided into jobs or exercises which are treated by means of illustrations and descriptions. These jobs are presented in a series of successive steps, graduating in difficulty from the simplest to the most complex. Questions have been included and follow the individual jobs, facilitating the work of isolating the various jobs from one another should a shorter course be desired. A great deal of work and study has been expended to make each unit complete and to have each represent the best modern practice.

Practical Mathematical Analysis

By H. Von Sanden and H. Levy. New York: E. P. Dutton & Comany. 194 pages, illustrated.

This thorough text on a very neglected but practical phase of mathematics has been translated splendidly by Mr. Levy and also greatly clarified by the inclusion of many illustrative examples. The book deals with methods used to obtain a numerical solution of mathematical equations and gives ways and means of attacking equations and checking the numerical results obtained. The accuracy of these results is clearly shown and the illustrative examples are well selected. After fundamental principles are outlined chapters are devoted to the slide rule and other calculating devices, rational integral functions, equations of a general character and graphical solutions to general equations. Existing methods of attack—for example, Simpson's rule, Gauss' method of integration and Newton's solution of transcendental equations—are explained and illustrated and new graphical and analytical methods are given. Many of the illustrative problems are electrical in character, and the book should find a ready use by specialists in electrical engineering who have a sound grasp of higher mathematics. It could also be used to advantage by colleges to aid students in getting a more practical grasp of the pure mathematics usually taught.

The Standard Electrical Dictionary

By T. O'Conor Sloane. Revised and enlarged by Prof. E. Watson. New York: Norman W. Henley Publishing Company. 790 pages, 497 illustrations. Price, $5.

This is really a handbook as well as a dictionary. The six thousand words, terms and phrases, alphabetically arranged, are defined in a very precise and complete manner. The volume covers the science of electricity in all its phases and its most recent developments, giving, besides the definitions, descriptions with illustrations of all electrical appliances and connections. The whole is a concise presentation of modern electrical theory, experimentation and engineering. To bring the book more up to date a dictionary of radio terms has been added.

Die Isolierstoffe der Elektrotechnik

Edited by Dr. H. Schering. Berlin: Julius Springer. 392 pages; illustrations, diagrams and tables.

Here is a useful and timely contribution to technical literature. Insulating materials are numerous, diverse as to properties and often seemingly erratic in behavior. Intelligent selection involves a balancing of advantages and disadvantages and requires first the assembling and comparing of physical data which during the period of active research have to be culled from many sources.

The volume under notice facilitates such comparison. It originated in a series of lectures under the auspices of the Elektrotechnische Verein of Berlin by specialists, each of whom discussed a particular class of substances and contributed the material now published under Dr. Schering's editorship. In so broad a field this plan of composite authorship has its evident advantages. Here the unavoidable dissimilarity of treatment is measurably offset by the unifying effect of the introductory and final chapters, the latter on testing, the former a very readable review of theoretical considerations, including, for example, reasons for variations in leakage resistance, phase angle and other physical properties, and presenting a considerable mass of significant data.

The labor involved in collecting so much good matter of value for reference, as shown by the many and definite citations of original sources, justifies regret at the absence of an index.

G. F. W.

Electrical Drafting and Design

By Calvin C. Bishop. New York: McGraw-Hill Book Company, Inc. 165 pages, illustrated.

This book supplements the usual course in mechanical drafting with instruction on those principles and methods peculiar to the drafting work that is ordinarily done in the office of an electrical engineer, contractor or power company. A variety of subjects are treated, and all the necessary charts and tables for the solution of the problems are included. The book should prove valuable in bridging the gap between the usual drafting course and office work.

Book Notes

Electrical Amusements and Experiments. By Charles R. Gibson. Philadelphia: J. B. Lippincott Company. 200 pages, illustrated.

A splendid book for boys who have an experimental turn. The many original experiments with simple apparatus are instructive as well as amusing.

Job Instruction Sheets on Practical Electricity. By W. B. Weber. New York: John Wiley & Sons. 62 pages, illustrated.

This is a text on elementary electrical practice written in the form of separate and distinct jobs. It follows the manuals developed for training during the war and should be very useful to elementary schools.

Small Electric Generating Sets Employing Internal-Combustion Engines. By W. Wilson. London: Ernest Benn, Ltd. 160 pages, illustrated.

Non-automatic, semi-automatic and full-automatic small electric generating sets using oil and gas engines are fully treated with the thoroughness characteristic of English writers. It should be valuable to all interested in this aspect of the industry.

Power Plant Machinery. Vol II. Details and accessories by W. H. James and M. W. Dole. New York: John Wiley & Sons, Inc. 257 pages, illustrated.

The second volume in the series describes with words, drawings and pictures the construction of the equipment used in power stations exclusive of boilers, stokers and coal and ash handling machinery. Reciprocating engines, turbines, pumps, compressors, heaters, condensers, cooling towers, spray ponds, pulsometers, air lifts and hydraulic rams are typical apparatus whose construction details are given and whose operating performance is outlined. The book is good as a descriptive text, but would have been more valuable had the authors included more detailed data on performance and costs.

Principles and Applications of Electrochemistry. By H. J. Creighton. New York: John Wiley & Sons, Inc. 424 pages, illustrated.

Professor Creighton deals with the principles and general theory of the subject in this volume, and Professor Fink in a later volume will take up more detailed technical applications. Electrochemistry has grown and developed greatly in the last few years, and a text of this caliber will be well received. Fundamental laws of electrolysis, conduction, migration of ions and dissociation are given, and the electrochemical principles of liquid and gaseous substances are outlined. Carefully selected problems are included with each chapter. While the treatment is technical and thorough, the author has written from the viewpoint of a teacher of the subject.

A. S. T. M. Standards—1924. Philadelphia: American Society for Testing Materials. 1,219 pages, illustrated.

This volume, issued triennially, contains 220 standard specifications, methods of test, definitions of terms and recommended practices. Among the subjects of interest to electrical engineers are a test for magnetic properties of iron and steel, specifications for various kinds of copper wires and cables, specifications for boiler and condenser tubes, methods of sampling coal, testing molded insulating materials and transformer and switch oils and the testing of rubber products such as mats, gloves, etc., used for electrical purposes.

News of the Industry

Earl Head of Great Western

Both Fleishhackers Sell Their Stock, Herbert Resigning as Well as Mortimer

NEWS printed last week of the acquisition by the Western Power Corporation of New York of control of the San Joaquin Light & Power Corporation and the consequent merger of the interests of the San Joaquin with those of the Great Western Power Company of San Francisco, long controlled by the Western Power Corporation, has been followed by the statement that Herbert Fleishhacker, vice-president of the Great Western, has added his resignation to the resignation previously reported of his brother, Mortimer Fleishhacker, who was president, and that both the Fleishhackers have sold all their stock in the company. Guy C. Earl, former vice-president, has been made president in succession to Mortimer Fleishhacker, J. B. Black remaining as vice-president. Previously the company has had three vice-presidents.

Three Bids for City Plant

Norwich, Conn., Likely to Sell Its Gas and Electric Properties to Fitkin Company

THREE competitive bids for the Norwich (Conn.) municipal gas and electric plant and properties have been received by the Mayor and Common Council of the city and were made public at the close of last week. The banking house of Bodell & Company, Providence, R. I., submitted a bid on behalf of the Central Connecticut Power & Light Company; another offer came from A. E. Fitkin & Company, New York, and the third proposal was presented by the Eastern Connecticut Power Company, whose headquarters are at Norwich. C. W. Taggart is manager of the gas and electric department of Norwich.

The Central Connecticut company's offer was $2,250,000 in cash, or $1,750,000 in cash and $750,000 in fifteen-year bonds, $50,000 payable each year. Fitkin & Company offered $2,600,000 in cash and to assume $400,000 outstanding bonds. The Eastern Connecticut company offered to buy the plant at its book value of $1,700,000 with a 20 per cent reduction in rates for power and light in force December 31, 1923, excluding street lighting and flat rates. This company also expressed its willingness to buy the plant at any bona-fide price that would be offered by any other purchaser and approved by the Public Utilities Commission of the state.

A special committee of the Common Council reported in favor of accepting the bid of A. E. Fitkin & Company, and this offer has been accepted subject to obtaining legislative authority to hold a municipal referendum election on the plan. Approval of the Connecticut Public Utilities Commission will also be necessary.

"There will be no change made in existing rates except in power," Mr. Fitkin is quoted as saying in an interview, speaking on the supposition that the plant would go to him. "The present rates are very satisfactory, but if our offer is accepted, we intend to reduce the rate for power so as to attract industrial concerns to the city."

Administration Turns to Underwood Bill

As Amended to Meet Secretary Weeks' Views, It Is Likely to Pass Senate—House Thought in Mood to Reject It—Bill Ignores Water-Power Act

CONTRARY to general prophecy, it appears as if the United States Senate will father a definite policy in regard to the Muscle Shoals plants instead of recommitting the matter to its agricultural committee. Before this appears in print it will probably have passed the Underwood bill, explained in last week's issue (page 1219), as modified to meet suggestions of Secretary of War Weeks and thus win administration support.

To meet one of the major objections of Secretary Weeks, Senator Underwood introduced an amendment under which the government would guarantee the interest and principal of bonds issued in the event of default by the lessee. Another amendment would change the amount of nitrogen to be produced annually. Instead of 10,000 tons being required the first year, the time is extended to the third year, advancing to 20,000 tons in the fourth year, 30,000 in the fifth year and 40,000 annually thereafter. The time for the leasing of the plant by the Secretary of War also would be extended from July 1 next to September 1, 1925. With reference to a War Department objection that the cyanamid process could not be used by the lessee, Senator Underwood said the Judge Advocate General of the army had settled that question in an opinion on the Ford bid, holding that a contract of the government with the American Cyanamid Company provided for use of patents by either the government or the lessee.

Amendments Accepted and Lost

Two amendments to the Underwood bill were passed by the Senate without a record vote. One provided that the lessee of Muscle Shoals must be either an American citizen or an American-controlled corporation. The other one struck out of the bill the requirement that funds of the operating corporation should be placed in Federal Reserve banks. An amendment by Senator Bruce to place the government employees at Muscle Shoals under the Civil Service Commission was voted down, 65 to 6, and another, by Senator Harris, to prohibit the lessee from transferring any lease or interest in Muscle Shoals without consent of the Secretary of War, was rejected, 37 to 29. A third amendment, also by Senator Harris, to give the Secretary of Agriculture authority to regulate the price and sale of fertilizer manufactured at Muscle Shoals, also was lost, 47 to 18.

Not to Go Under Water-Power Act

After an extended argument between Senator Underwood and Senator McNary, Republican, Oregon, the Senate rejected an amendment by the latter to require that power development at Muscle Shoals should come under the regulation of the federal water-power act. The vote was 34 to 29.

It was apparent early in the Senate discussion last week that the withdrawal by Henry Ford of his offer was taken seriously. Apparently no one has any thought that he can be induced to renew it. Senator Norris, in the course of his remarks, presented the following calculation of the power possibilities of Dam No. 2:

	Horsepower
99.4 per cent of the time.....	87,300
97 per cent of the time.....	100,000
88.3 per cent of the time.....	141,000
66⅔ per cent of the time.....	205,000
50 per cent of the time.....	306,000
20 per cent of the time.....	600,000
7 per cent of the time.....	1,000,000

Senator Norris painted a glowing picture of the possibilities of giant power and said the only fly in the ointment is the danger of monopoly. "With a network of wires spread over the country," he said, "carrying light, power and heat to all the people, it is absolutely incumbent upon governmental authority to provide by proper regulation that such a great plant shall not be utilized for the financial benefit of individuals or corporations, and that those controlling such a system shall not be permitted in any way to utilize the great power in their hands without restraint and regulation.

"If Muscle Shoals is turned over to one corporation, particularly if that corporation is given a governmental subsidy in the way of cheap money, on a basis of one hundred years of time, the corporation permitted to use this cheap power in its own manufacturing business would be given a governmental subsidy. This is an undue advantage—an advantage backed up by money of the taxpayers of the country—over every other manufacturing establishment of a similar nature in the entire South."

Senator Underwood, in explaining the

proposal which he wished to substitute for the committee bill, declared that he was "not contending that it is unwise that electric power be massed and that industry should get the benefit of it. Too much water runs down the streams of America that is not harnessed, but we have made a dedication of this project to patriotism, to the life of the nation, to the power of the government, and to the upbuilding of the toiling masses of American people who are engaged in agricultural endeavor." He characterized the committee's substitute for the Ford offer as a power bill and his own substitute as a national defense-fertilizer bill.

Senator Wadsworth of New York strongly opposed the entrance of the government into commercial business at Muscle Shoals. Whether under such conditions employees were put under Civil Service regulations, as proposed by Senator Bruce of Maryland, or were not, he said, the idea was hopeless in the matter of efficient management. He wanted legislation that would be attractive to private operators. Senator Harrison of Mississippi supported the Underwood bill, scoring all the bids now before Congress as inadequate and ridiculing Senator Norris' proposal as one to put the enterprise in the hands of government chemists "who receive $2,500 a year" and know nothing about business.

Fears Alabama Power Company

In the course of Wednesday's debate a sharp attack on the Underwood bill was made by Senator McKellar of Tennessee, who charged that it virtually "would give Muscle Shoals over to the Alabama Power Company." Senator Underwood demanded proof. As a compromise with Senator Norris he consented to an amendment requiring the conversion into fertilizer of nitrogen not needed for national defense.

A proposal to refer the matter to a joint committee of Congress took legislative form in a concurrent resolution offered by Representative Kearns. This bill provides that the joint committee be composed of three members of the Senate committee on agriculture and three members of the House committee on military affairs. The committee is "to investigate and report to Congress, as speedily as possible, a feasible plan for the utilization of the properties of the United States at Muscle Shoals in such a manner as to insure adequate production of fixed nitrogen for use in national defense, the encouragement of commercial development and manufacture of nitrogenous fertilizer products for the benefit of agriculture, the most beneficial use of surplus power not required for nitrogen production and an adequate return to the government for its investment in power plants."

The bill provides that the joint committee is to examine the offers already made and to invite additional bids, if it should be deemed advisable. It is authorized to conduct such negotiations as may be necessary to enable the committee to recommend to Congress the most satisfactory method of dealing with the property and requirements. It contains the significant suggestion that the committee may report separate plans for the utilization of the nitrate production facilities and the surplus power which will be generated.

A Government Ownership Bill

The Underwood measure is regarded primarily as a government-ownership proposition. It does provide for the lease of the properties to private enterprise, but the conditions are such as to make such disposition unlikely. It is very apparent that the Senate does not expect a lessee to come forward as the greatest care is being exercised in perfecting the government-ownership alternative.

Strangely enough, the House, which voted overwhelmingly for the Ford bill, is expected to vote down the bill which the Senate is expected to pass. Many members of the House voted for the Ford bill because they were anxious that no further government money be expended at Muscle Shoals. The Senate is strengthening the mandatory operation feature of the Underwood bill and with each amendment is making it less acceptable to the other chamber. The probabilities all are that the House, the membership of which is overwhelmingly against public excursions into commercial business, will vote down the measure.

Umatilla Rapids Project

Interior Department Report Puts Cost of Dam and Plants at $45,000,000

A REPORT on the combined power and irrigation project at Umatilla Rapids, in the Columbia River Valley, in Oregon, has been made by the engineers of the Interior Department. The estimated cost of the dam and completed power plants is $41,600,000, and the total cost is placed at $45,000,000, including the cost of financing.

The report deals at length with the future market possibilities of power, which at the peak load will be 760,000 hp. and may be developed at a cost of $59 per horsepower. The suggestions include the electrochemical and metallurgical industries, electrification of railroads, a fixation plant for nitrates, industrial heating, and sale to public utilities, which, it is asserted, will find it cheaper to purchase this power than to develop it independently. The cost of generation when a market for power shall be developed is put at $7.70 per horsepower-year.

The dam proposed at the lower end of the rapids would raise the water level from the 253-ft. elevation to 310½ ft., flooding approximately 5,230 acres of land and making it necessary to relocate 33 miles of main-line railroad track. Among the construction features are an embankment 2,200 ft. long on the Oregon side with a spillway 1,100 ft. long across the main channel, with twelve 66-ft. gates; a power house 2,200 ft. long across the flood channel, a navigation lock 1,000 ft. down stream, a fishway and a gravity section dam.

A superpower system linking Umatilla Rapids with California is declared practicable as a future development, and it is pointed out that California is likely to have brought all her potential water power into use within the next eleven years, when outside power may have a market there.

Turbines can be used that will allow the fish to ascend the stream, it is stated, and in three and one-half years the dam and power house can be built and one-half the electrical and hydraulic equipment installed.

A seven-year program is suggested for completion, with expenditures of $1,500,000 the first year, nearly $5,000,000 the second, and $11,000,000 the third.

Wisconsin Valley Company Buys Rhinelander System

Another important Wisconsin merger was made public last week when C. C. Yawkey, president of the Wisconsin Valley Electric Company, which owns and operates five hydro-electric plants supplying light and power service to Wausau, Marathon City, Stevens Point, Edgar, Merrill, Mosinee, Tomahawk and numerous smaller communities, announced that this company had acquired the Rhinelander Light & Power Company's generating and distributing properties, serving Rhinelander, Crandon, Elcho, Pelican Lake and many other northern cities and towns. For the present there will be virtually no change in the management of the Rhinelander properties except that E. A. Forbes, president, will retire.

Acquisition of the Rhinelander system places in the hands of the Wisconsin Valley Electric Company the opportunity of controlling all the power and light business in the Wisconsin River valley from Stevens Point north to Rhinelander. The terms of the purchase were not made public, but, according to the valuation of the Wisconsin Tax Commission, the properties are worth about $500,000. The company has a water-power plant on the Wisconsin River and an auxiliary steam plant in Rhinelander. The high-tension transmission line of the Wisconsin Valley Electric Company, which now reaches as far north as Tomahawk, will be extended from that place to the Rhinelander properties which are 18 miles up the river.

Meter Experts in New York

The national N. E. L. A. meter committee, which was holding its fall meeting in New York City, was invited on Tuesday evening of this week to attend a regular meeting of the Metropolitan Section meter committee. Representatives of the Sangamo Electric Company, the Westinghouse Electric & Manufacturing Company, the General Electric Company and the Sewickley Electric Manufacturing Company were also present as guests. An address of welcome was made by S. G. Rhodes, assistant to the vice-president of the New York Edison Company. The speakers were William S. Davis, Public Service Electric Company, Newark; Roy Fryer, Union Gas & Electric Company, Cincinnati; H. R. Woodrow, Brooklyn Edison Company, and C. G. Ingalls, Boston Edison Company, who spoke on a method he had developed for testing direct-current watt-hour meters with particular reference to metering the service of transportation companies.

Hoover on Radio Control

Advises Deferring Legislation Till Results of Development Become Clearer

SECRETARY HOOVER, who has hitherto actively supported the radio-regulating bill of Representative White, which has twice failed to pass Congress, has modified his views on the desirability of immediate legislation of a thoroughgoing nature along such lines. Mr. Hoover has been influenced by the rapid developments in the radio art and the present impossibility of estimating just what changes they will bring. He says in a letter to Representative White:

"I am enclosing herewith a suggestion of a very short bill clarifying the powers of this department as to radio regulation as to interference. It does not pretend to confer complete regulatory authority, nor does it cover many matters which must sooner or later receive legislative attention. It is intended only to enable the department to retain firm control of a situation which is very rapidly changing, in which there are some elements of danger. If such a bill is passed, it will give time for more consideration of the whole subject.

"We have long agreed that this industry will ultimately require exhaustive legislation. . . . I feel, however, that the new developments in the art during the last twelve months have taken such a departure as to require somewhat further time for ascertaining its ultimate result to the public before we can adequately determine the proper course of legislation. There is a probability that by the end of that time we may require wholly new legislative provisions.

NO RADIO MONOPOLY

"The short bill proposed will reinforce the fundamental situation so that no public damage can result from delay, whereas much public advantage might result from a further clarity of our knowledge as to the application of this new system of communication. As you are aware, there is no monopoly in the radio world at the present time, there being more than five hundred broadcasting stations, of which not more than four are the property of any one institution."

Secretary Hoover proceeds to give an analysis of present radio conditions and concludes:

"The suggestion which I inclose is necessary under whatever regulatory theory may develop. It merely affirms the authority now exercised by the department over wave lengths, power, apparatus and time of operation. It is in the nature of emergency legislation urgently needed to preserve the situation in the public interest until a final and complete legislative policy can be adopted. It contains the provision reserving federal control over the ether. Its other provisions are merely condensed statements of powers conferred in the bill which you introduced as reported by the House committee."

The short bill indorsed by Secretary Hoover simply adds the following provision to the existing law, which was passed in 1912: "The wave length of every radio transmitting station for which a license is now required by law, its power, emitted wave, the character of its apparatus and the time of transmission shall be fixed by the Secretary of Commerce as in his judgment and discretion he shall deem expedient and may be changed or modified from time to time in his discretion."

Initial Unit of Long Beach Steam Plant Goes on Line

After establishing a speed record for construction the Southern California Edison Company, placed the first 35,000-kw. unit of its Long Beach steam plant on the line December 3. Originally planned for completion in fourteen months, work on the plant was rushed on an emergency schedule because of the power shortage brought about by the drought, with the result that the first unit was brought into service eleven months after excavation was started.

Contributing to this feat was the record-breaking transcontinental shipment noted in the ELECTRICAL WORLD for August 30 and September 6, twenty-two freight cars having made the trip from Schenectady, N. Y., to Long Beach in eight days. Every modern device for efficiency and economy in steam generation has been used in the new plant, with the result that it will produce 350 kw.-hr. per barrel of oil in comparison with 225 kw.-hr. per barrel in the original Long Beach plant.

With the placing in service of the second unit in the plant within the next few weeks and the installation of additional equipment rated at 55,000 hp. in the Big Creek hydro-electric development now under construction, the generating capacity of the Southern California Edison system will be brought up to a total of 672,000 hp.

Interstate Company Merger in Indiana Complete

The acquisition (already noted in the ELECTRICAL WORLD) by the Interstate Public Service Company of Indianapolis of the properties of the Indiana Power Company, the Knox & Sullivan County Light & Power Company and the Consumers' Power Company, all in the southwestern part of Indiana and interconnected with Vincennes, has been finally approved and ratified.

The Indiana Power Company serves Vincennes and other places with a total population of 54,600, in which it has approximately 12,000 electric light and power customers. The Consumers' Power Company is serving Princeton and other cities with a population of approximately 20,000, in which it has nearly 4,000 light and power customers. The Knox & Sullivan County Light and Power Company is composed of a smaller group of properties serving a population of 3,000.

The new properties include a 23,000-kw. generating station at Edwardsport with standby stations at Vincennes, Bloomfield and Princeton. The acquisition of these properties makes a total of 70,000 electric light and power customers for the Interstate, which is now serving approximately 150 cities and towns.

Mercury-Turbine Progress

Developments at Hartford Central Station Are Recounted for Engineers

INCREASED efficiency in production of power by the mercury-vapor process is anticipated in the near future, according to B. P. Coulson, assistant to W. L. R. Emmet, General Electric Company. Mr. Coulson addressed the Providence sections of the A. I. E. E. and A. S. M. E. last month at the rooms of the Providence Engineering Society. Interest, he said, centered upon the installation of the Hartford Electric Light Company, which had delivered a total output of 2,429,500 kw.-hr. and 54,308,127 lb. steam from the beginning of operation in September, 1923, to October 1, 1924, with a total fuel-oil consumption of 630,917 gal. There is now under construction for the Hartford company an improved mercury boiler of the sectionalized type designed for operation at 70 lb. per square inch. This will drive a mercury turbine of the three-stage type, and the boiler should be ready for shipment in December. It is anticipated that about 12 per cent more of the energy of the mercury vapor will be realized by this improved unit, and running such equipment on a base load it is expected that 1 kw.-hr. can be developed on about 10,000 B.t.u., compared with about 15,500 B.t.u. in the best large steam generating stations.

The new boiler for Hartford, Mr. Coulson said, will be made up in six units with tubes 3 in. in diameter. These tubes will be provided with cores, and they can be removed for cleaning if necessary by chiseling off the header weld. The tubes will have tapered ends to receive radiant heat from the fire and will be about 5 ft. long. The rating of the improved unit for Hartford will be about 4,200 kw., of which 1,800 kw. will be in the mercury-turbine-driven generator and the rest in steam supplied to the Dutch Point plant mains. The speaker said that one large central station is being built in this country with foundations adequate to carry a future mercury boiler and turbine installation if found desirable. He was of the opinion that the cost of adding capacity in the form of the mercury-vapor apparatus at an established plant would be less than the cost of adding steam-generating-unit capacity on account of the saving in real estate and buildings resulting from the use of the mercury-vapor process. Putting the case another way, by burning about 25 per cent more fuel, the capacity of a generating station can be increased about 100 per cent by the mercury boiler.

Carnot Celebration Is Held in New York City

The hundredth anniversary of the date when the French physicist Nicholas Leonard Sadi Carnot announced the second law of thermodynamics was celebrated at the Engineering Societies Building, New York City, on the evening of December 4. Representatives of all the engineering societies united in paying tribute to Carnot, and appro-

priate addresses were made by noted engineers and physicists.

President-elect William F. Durand of the American Society of Mechanical Engineers presided and after pointing out the tremendous value of Carnot's contribution to the art introduced the speakers. Ambassador Jusserand of France, through a representative, thanked the American engineers for their tribute to Carnot and indicated the value of science in cementing Franco-American relationships. Prof. M. I. Pupin in a notable address explained the meaning of the second law of thermodynamics and illustrated the universality of its application. W. L. R. Emmet gave an illustrated lecture showing the development of power equipment as based on the principle of Carnot.

President to Light National Christmas Tree

President Coolidge has consented to participate in the ceremonies incident to lighting the "national Christmas tree," which will be planted in the grounds near the White House. The invitation to turn on the lamps which will illuminate the tree was extended by Representative Hamilton Fish, Jr., of New York, F. M. Feiker, vice-president of the Society for Electrical Development, and T. H. Ormsbee of the same organization.

The President, it may be recalled, performed a similar service at Christmas time last year, when the first national Christmas tree was dedicated. The success of the idea last year prompted the Society for Electrical Development to arrange to have a fine specimen of spruce selected for transplanting, so that a growing tree could be used for this purpose each year. The American Forestry Association, the Washington electric utilities and other organizations are participating in the undertaking. The tree will be illuminated with 1,500 lamps and appropriately decorated. It is to be dug up and prepared for shipment at Amawalk, N. Y., today (December 13).

Canadian Energy Output

Central Stations in 1923 Generated More than Eight Billion Kilowatt-Hours

THE Canadian government has just issued a report on the central electric station industry for 1923 which shows that, compared with the previous year, there were increases in capital, revenues and output, also in installations, pole-line mileage and customers served. An analysis of the output and number of customers shows in a rough way the manner in which the energy is used. In the Yukon, where large blocks of power are used by mining companies, the average consumption per customer was 23,861 kw.-hr. during the year. Quebec was second with 9,488 kw.-hr. and Ontario third with 8,688 kw-.hr.

Not only are the hydro-electric stations able to produce power much cheaper than fuel stations, but they show a much higher ratio of utilization; i.e., their annual output is a much higher percentage of their maximum capacity. In hydro-electric stations in Ontario this ratio was 52.6 per cent, in Quebec 50 per cent, in Manitoba 42 per cent, in British Columbia 38.8 per cent.

The number of power plants in Canada in 1923 was 532 as compared with 522 in 1922. The capital investment stood at $581,472,583 as against $568,068,752 in the previous year. Gross revenue was $91,141,296, an increase of $8,812,430. Operating expenses totaled $54,968,077, an increase of $5.005,433. The number of customers served during the year totaled 1,122,900, a betterment of 169,355. The electrical energy generated was 8 094,333,000 kw.-hr. as compared with 6,740,750,000 in 1922.

Another government report shows that during the first six months of the present fiscal year, April to September inclusive, Canada exported to the United States 640,385,778 kw.-hr. of electrical energy, a decrease of 49,571,731 kw.-hr. compared with the corresponding period in 1923, but an increase of 155,165,193 kw.-hr. over the corresponding period in 1922.

Duke Pledges Southern Power Bonds to Found College

Approximately three-fourths of the holdings of James B. Duke in the Southern Power Company, of which he is president, are to be pledged by him, along with other securities, to establish a trust fund of $40,000,000 for the financing and maintenance of a great educational institution in North Carolina and for other educational and charitable purposes. A fund of $6,000,000 will be made immediately available for acquiring lands and equipping thereon buildings suitable and adequate for an institution of learning. The bequest will be administered by fifteen trustees, who will form a self-perpetuating body. The money, it is provided, may go to Trinity University at Durham, N. C., if it sees fit to change its name to Duke University, and announcement is made that that university will do so.

Hydro-Electric Plants on Tippecanoe River, Indiana

CONSTRUCTION of the largest dam for hydro-electric purposes yet projected in Indiana has begun in the Tippecanoe River at Oakdale by the Indiana Hydro-Electric Power Company, which was organized in 1921 as a subsidiary operating company of the Middle West Utilities Company for the development of hydro-electric properties on this historic stream. The company has had in operation since last year its initial hydro-electric development on the Tippecanoe, which is at Norway, Ind. The installed capacity of this station is 8,500 hp., and the energy generated is fed to the transmission lines of the Interstate Public Service Company in Indiana and the Central Illinois Public Service Company in Illinois. In addition to the Norway property, sites for the further development on the same river, aggregating about 21,000 hp., were acquired at Oakdale and Springboro.

The Oakdale site is in Carroll County, 6 miles below Monticello, Ind., and 10 miles down the river from the Norway plant. This station will have an installed generating capacity of 14,000 hp., and the energy generated will be purchased by the Central Illinois Public Service Company, the Interstate Public Service Company and the American Public Utilities Company. Work is now well under way, and it is estimated that the plant will be ready by July 1, 1925. The contract for its construction has been let to the L. E. Myers Company of Chicago, and the cost of the project is computed at about $2,000,000. Roger M. Freeman of New York, who was the consulting engineer for the Norway dam, is also the engineer of the work at Oakdale. The dam will be 42 ft. high and 1,300 ft. long—somewhat larger than the dam at Norway, which is 30 ft. high and 1,000 ft. long. The two dams, which are shown above as they now are, are about 8 miles apart.

The outline of the Tippecanoe River will be changed for 25 miles by the construction of the dams, which, when development is completed, will form three beautiful lakes. Lake Shafer, formed by the back water of the Norway dam, is 13 miles long and more than a half mile wide. A similar lake, not so large because of the greater fall and higher banks, will be formed at Oakdale.

Empire State Electrical Engineers Meet

Overhead and Underground Distribution, Rural Electrification, Transmission, Operation and Electrical Apparatus Are Discussed at Syracuse

IN ONE of the most notable meetings ever held by the Electric Section of the Empire State Gas and Electric Association more than 125 engineers, representing nearly every electric utility company in the state, gathered at Syracuse on December 4 and 5, under the chairmanship of H. W. Watt of the Westchester Lighting Company, Mount Vernon, to discuss some of the problems now confronting light and power companies.

The question of aërial cables versus open wiring was taken up by J. O. Montignani, Westchester Lighting Company. Asserting that shade trees are probably the most common source of trouble and interruption to lines and that the only complete remedy for this is underground construction, he said that this remedy in the majority of cases is not economically justified. Aërial cable construction using lead or jute and steel-armored cables suspended from a steel messenger and hung low enough to avoid the most troublesome branches is a compromise between open wire and underground cables, and it has been found to work out very satisfactorily in many instances, particularly for tie lines or transmission lines up to 16,000 volts.

W. C. Blackwood thought that for distribution voltages the best method to follow in running through trees was the use of tree wire bunched and tied together with marlin twine. A special ozone-proof rubber insulation on these wires is necessary. The New York & Queens Electric Light & Power Company is using this construction with very good results.

As regards the proper selection of fuses for transformers and branch lines, Mr. Montignani said that a number of companies are discontinuing the use of porcelain cut-outs except at points quite remote from the source of supply and are replacing them with types of higher rupturing capacity such as the expulsion type of fused cut-outs. One company is using oil-fused cut-outs exclusively.

Three other papers, relative to pole conservation and preservation, field inspection of poles and lines and the preparation and care of line maps and records, were also presented and will be abstracted in subsequent issues of the ELECTRICAL WORLD.

NEWSPAPER PUBLICITY

"Public Utilities and Their Public Relations" was the subject of an excellent talk by W. K. Bradbury of the Niagara Falls Power Company. He urged public utilities to advertise in the newspapers regularly and systematically. The newspapers are the greatest medium for publicity, and by using regular space and supplying graphically written and fact-furnishing copy the reading public can be brought in touch with the companies. In this way an opening for the dissemination of news about the utility companies has been established and a sympathetic hearing from the public has been gained in advance. The copy must be truthful and without direct propaganda, and though presented by technical men, it must be in such terms that the public can understand it. Mr. Bradbury described in detail the advertising campaign that his company has been carrying on in 217 newspapers during the past fifteen months.

The work of the underground distribution committee was presented in six papers covering methods of fault location in cables, use of multiple versus single-conductor cables, progress in high-tension cable manufacture, fireproofing cables, underground conduit construction and sectionalizing devices.

PROGRESS IN HIGH-VOLTAGE CABLES

R. A. Paine, Jr., Brooklyn Edison Company, said that remarkable strides had been made in the manufacture of high-voltage cables, particularly as regards the mechanical construction of 33,000-volt cables such as are being used by his company, which in the past year has bought approximately 340,000 ft. of three-phase, 350,000-circ.mil sector-conductor cable rated at the above voltage. Factory inspection during the manufacturing process has been found very essential, as it is possible in this way to keep a careful check throughout the various phases of manufacture and to detect faulty construction before it has progressed too far. The cable made during the past year, according to Mr. Paine, shows better and more uniform saturation, owing largely to changing the nature of the oil and changing the time devoted to the various stages. Extensive research work on the materials, paper and impregnating oil is being carried on by the cable companies, and in this work they are receiving close co-operation from the manufacturers of cable paper and from the oil refiners.

INTERCONNECTION IN NEW YORK

The work of the transmission lines committee, as reported by C. A. Bacon, Adirondack Power & Light Corporation, was largely concerned with the technical problems involved in interconnecting the different transmission systems of New York State at 110,000 volts or 132,000 volts. The report contains a short-circuit study of the system as a whole to determine the probable necessary rupturing capacity of oil circuit breakers and proper relaying of the system, voltage regulation, methods of metering, operation and recommendations for electrical clearances for 132,000 volts.

B. H. Shepard, chairman of the rural lines committee, gave an able discussion of the rural electrification problem in New York State, pointing out what the utility companies would have to do in order to meet the public demand for wider service. He showed that there are 1,500,000 people in New York in towns of 1,000 or fewer people. Estimating four persons to a family, this would mean 375,000 families, 80 per cent of whom could be supplied with service, thus making 300,000 customers. He also discussed the type of rural construction that would have to be used, a type which, following good engineering practice, would cost 30 per cent less than good construction for cities and the larger towns.

Ice troubles in hydro-electric plants were discussed by John Murphy, electrical engineer of the Department of Railways and Canals in the Canadian government. He outlined the fundamental principles underlying this problem and described methods of combating frazil ice.

R. F. Burnett of the People's Gas & Electric Company, Oswego, was elected chairman of the Electric Section for the coming year, with R. A. Paine, Jr., as vice-chairman.

Central-Station Illuminating Engineering Class

TWO men from Canada, two from Texas, two from New York and one each from Minnesota, Utah, Georgia, Illinois, Missouri and the District of Columbia made up the first class in illuminating engineering for central stations, which, as already told in the ELECTRICAL WORLD, traveled from Chicago to Washington by way of Boston and New York to gain instruction.

Left to right—R. D. Myers, Northern States Power Company, St. Paul; L. B. Gawan, Utah Power & Light Company, Salt Lake City; C. A. Musson, United Electric Light & Power Company, New York; H. I. Mark, Jr., New York Edison Company, New York; I. D. Smith (secretary-treasurer), Toronto Hydro-Electric Commission; F. E. Price (president), Georgia Railway & Power Company, Atlanta; M. R. Rodger (vice-president), Central Illinois Public Service Company, Springfield, Ill.; P. R. Labelle, Shawinigan Water & Power Company, Montreal; J. H. Potts, Potomac Electric Power Company, Washington; J. M. Brantley, Union Electric Light & Power Company, St. Louis; H. C. Webb, El Paso (Tex.) Electric Railway Company; C. J. Blum, San Antonio (Tex.) Public Service Company.

City and Province Protest

Agitation in Manitoba Over Control of Lake of the Woods and Winnipeg River

CONTROL of the waters of the Lake of the Woods in western Ontario and their flow into the Winnipeg River is, according to a correspondent of the Toronto *Financial Post*, causing no little agitation in the Province of Manitoba and its chief city, Winnipeg. The Dominion government, which had made plans to build a new dam in the river, is now proposing to make an arrangement with pulp and paper interests to rebuild an existing dam at Norman. This plan is held to be highly dangerous to the power interests on the Winnipeg River.

The water-power developments of these pulp and paper interests, owned by the Backus Company, are near the outlet of the lake, whose area this company virtually controls. Lower down on the river are the White Dog Falls, where the power site is also controlled by the Backus interests, and still lower, at Point du Bois and at Lac du Bonnet, in the Province of Manitoba, are the power developments of the city of Winnipeg and the Manitoba Power Company, otherwise the Winnipeg Street Railway. The power interests there fear that dependable flow may be interfered with at times in the interest of the power works above them.

There are a considerable number of complications involved in the question of water levels in the Lake of the Woods. In the first place it is subject to regulation by an international joint commission. In the next place there is a question of jurisdiction between the Dominion government, which acquires control because of the international aspect of the question, and the Province of Ontario, which has control of the power sites. In the Province of Manitoba the power sites are under Dominion government jurisdiction, and the government of Manitoba enters the case not because of any direct jurisdiction, but in the interests of the people of the province.

The Backus proposal is that the Dominion government should subsidize the company for rebuilding the Norman Dam, which is in bad condition, to the extent of $800,000; that the company should own the dam and regulate it under Dominion government supervision. Winnipeg interests claim that the Dominion government will save nothing by this arrangement and, on the other hand, that it is needlessly imperiling the power developments on the lower Winnipeg River. Winnipeg interests refuse absolutely to regard regulation of the dam under instructions from the Dominion government as at all equivalent to direct regulation by government officials.

The importance of the matter to Winnipeg is shown by the statement made by Hydro officials to the effect that owing to low water levels, caused by the failure of the Norman Dam to hold water this summer, the system is threatened with a shortage of power. Similar conditions prevail at the plant of the Winnipeg Railway Company, only a few miles distant, at Lac du Bonnet.

Briefer News

N. E. L. A. Rural Committee to Meet at Ames, Iowa.—The rural electric service committee of the National Electric Light Association, previously scheduled to meet at St. Louis on December 16, will instead meet at Ames, Iowa, on December 18, at the Hotel Sheldonmunn.

Metric Association to Meet in Washington.—December 29 and 30 are the dates for the meeting of the Metric Association in Washington, the same week as the meeting of the American Association for the Advancement of Science. Prof. A. E. Kennelly and other prominent advocates of the metric system are scheduled to speak.

Nature or Nature Faking?—The Jasper-Stacy Company of San Francisco writes to the ELECTRICAL WORLD: "We are building an electric power-line system for the development of 100,000 acres in the Casa Grande Valley, Arizona, and sometimes nature makes it convenient to utilize what we find on the way, as shown by the inclosed photograph. The apparent pole in the photograph is a saguaro, a type of giant cactus."

Five-Million-Dollar Extension to Manitoba Hydro System Planned.—The announcement is made from Winnipeg that plans for a three-million-dollar power plant at Slave Falls and a two-million-dollar transmission line to Winnipeg have been completed for the Manitoba hydro-electric system. No date has been set for the commencement of the work, which will depend upon the final settlement of the dispute concerning the control of the Norman Dam.

Houston Company May Offer to Buy Bryan (Tex.) Municipal Plant.—At a recent meeting of the City Commission of Bryan, Tex., S. R. Bertron, Jr., vice-president of the Houston Lighting & Power Company, asked permission on behalf of that company to make a valuation of the municipal public utility plants with the view of submitting a proposition to purchase the plants and franchises. This action of the Houston company is taken to mean that it contemplates entering the electric power transmission field of south Texas.

Rate Reduction in Willamette Valley Towns.—A voluntary reduction of approximately 6½ per cent in the lighting and cooking rates of the Mountain States Power Company, Albany, Ore., has been put into effect in all the towns and rural territory served by that company in its Willamette division. Among the towns affected are Albany, Corvallis, Dallas, Monmouth and Cottage Grove.

North American Company to Spend $30,000,000.—Edwin Gruhl, vice-president and general manager of the North American Company, New York, which controls central-station companies in Cleveland, St. Louis, Milwaukee, Racine and elsewhere, has announced that the capital expenditures of the holding company in the near future in all the states in which it operates will total approximately $30,000,000, not including substantial improvements to the plants of the newly acquired Peninsular Power Company.

Fight in Superior, Wis., Over Electric Plant to Begin Again.—A renewal of the legal battle between the city of Superior, Wis., and the Superior Water, Light & Power Company over the ownership of the company's plants has been indicated by an announcement from the city that it will answer in court the complaint of the utility company that a valid contract existed by which the city was to purchase the company's plants and that its terms were violated when the city sought to start condemnation proceedings. The dispute is of five years' standing.

Tennessee Electric Power and Chattanooga. — The Tennessee Electric Power Company figures prominently in a handsome publication, "Industrial Chattanooga," published by the Chattanooga Manufacturers' Association, which contains a halftone picture of the Hale's Bar lock and dam and an article on "The Future of the Tennessee River as a Source of Power" by Major Harold C. Fisk, district engineer. The company, pointing to the fact that 90 per cent of the city's industries are electrically driven, adds that 275,000 hp. from its hydro-electric and steam plants guarantees ample power for industries locating in the territory.

High-Tension Line to Traverse Wisconsin.—It is officially stated that the North American Company will spend at least $10,000,000 in Wisconsin next year, one of its undertakings to be a high-tension transmission system extending virtually the entire length of the state and connecting the Lakeside power plant south of Milwaukee with four power stations on the Menominee River along the northern boundary. The company's lines now stretch from

Milwaukee to Plymouth, 100 miles, and will ultimately be connected with the hydro-electric plants of the Peninsular Power Company on the Menominee River, just taken over.

Frick Company Will Electrify Seven Coke Mines.—The H. C. Frick Company has announced plans for the expenditure of $2,000,000 to electrify completely seven coke mines in order to meet the increased demand for production from the United States Steel Corporation and its subsidiaries.

Yadkin River Plant Increased.—A 35,000-hp. turbine directly connected to a 23,160-kva. generator has been added to the main power house of the Tallassee Power Company on the Yadkin River at Badin, N. C. This completes the power house, which now has a generating capacity of 92,540 kva. The new unit will function as a spare and will allow the high water of winter and early spring to be turned into useful power instead of running to waste over the dam. It means a larger production of aluminum at Badin with an increasing payroll and larger amount of power available for general utilities.

Dallas Company to Construct Another Large Unit.—The Dallas (Tex.) Power & Light Company, which completed a 15,000-kw. turbine-generator in October at a cost of $2,000,000, thereby becoming freed from the necessity of purchasing power from Fort Worth and Waco, has obtained the authority of the City Commission to install an additional unit, which will have a rating of 20,000 kw. and cost with auxiliaries $2,582,739. Work will, it is announced, begin at once on the new installation, which will take care of the growth expected by 1927 and prevent any necessity for the company again to purchase power.

Expansion of Binghamton (N. Y.) Company Authorized.—The New York Public Service Commission has consented to the purchase by the Binghamton Light, Heat & Power Company of 500 shares of the common stock of the Afton-Windsor Light, Heat & Power Company, Center Village, which now furnishes electricity in the towns of Windsor and Colesville and village of Windsor, Broome County, and in the town and village of Afton, Chenango County; of the franchises and systems of the Cincinnatus Light & Power Company, and of the municipal electric plant of the village of Newark Valley, Tioga County.

Webster, S. D., Gives up Municipal Plant.—After six years of consideration and debate the citizens of Webster, S. D., have voted by a two-thirds majority to abandon their municipal lighting plant and purchase electrical energy from the Northwestern Public Service Company. This company took over the city equipment on December 1 for a consideration of $20,000, and from that date a reduction of 5 cents per kilowatt-hour for lighting and proportionate rates for power and heat went into effect. The old plant will be equipped with alternating-current machinery and kept ready for emergency. A high-tension line will be constructed from Bristol, and as soon as it is completed to Webster will be extended to the villages of Roslyn and Grenville, which had previously granted franchises to the Northwestern company.

Sir Adam Beck's Former Secretary Sentenced.—E. Clarence Settell, former private secretary to Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, has been found guilty of attempted stealing in connection with the cashing of a Hydro-Electric check for nearly $30,000 and has been sentenced to three years in the penitentiary. It will be remembered that when Settell was arrested while on the point of leaving Canada he sent a letter to Sir Adam Beck which contained charges of wrongdoing against past and present engineers of the commission. On the demand of Sir Adam Beck an inquiry was instituted by the government. The charges proved to allege inefficiency and loose management rather than grave malfeasance. Some were trivial in their nature, and others met with emphatic denial. Judge Snider, who conducted the inquiry, has not yet rendered his findings.

St. Petersburg (Fla.) "White Way" to Be Lighted by City.—The "white way" systems now near completion in St. Petersburg, Fla., are to be lighted with power from the municipal power plant, instead of from the plant of the Pinellas County Power Company, according to plans made by the City Commission. It is not proposed, however, to interfere now with the present system of street lights, power for which is supplied by the Pinellas County Power Company under a contract which does not expire until September 25, 1926. The municipal plant was recently enjoined from selling power to individuals, but its right to supply power for its own use has never been questioned in court. To compensate the Pinellas County Power Company for any loss it may incur through the city's taking over the new lighting system, it is proposed that a committee enter into negotiations with the power company officials.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 5 issue, page 50, for latest list.]

Kentucky Association of Public Utilities—Louisville, Jan. 15-16. E. F. Kelley, Louisville Railway Co., Louisville.

Electrical Safety Conference—New York, Jan. 21. R. B. Shepard, 109 Leonard St., New York.

Western Association of Electrical Inspectors—Brown Hotel, Louisville, Ky., Jan. 27-29. G. M. Miller, 1304 South Seventh St., Louisville.

Wisconsin State Association of Electrical Contractors and Dealers—Pfister Hotel, Milwaukee, Jan. 28-30. H. M. Northrup, 23 Erie St., Milwaukee.

American Institute of Electrical Engineers—New York, Feb. 9-12; St. Louis, April 13-17; Saratoga, N. Y., June. F. L. Hutchinson, 33 West 39th St., New York.

Wisconsin Chapter of Electrical Inspectors—Pfister Hotel, Milwaukee, Feb. 17-19. A. C. Schultz, Milwaukee.

American Electrochemical Society—Niagara Falls, N. Y., April 23-25. C. G. Fink, Columbia University, New York.

Southwestern Public Service Association—Houston, Tex., May 19-22. E. N. Willis, 403 Slaughter Bldg., Dallas.

National Electric Light Association—San Francisco, June 15-19. M. H. Aylesworth, 29 West 39th St., New York.

British Columbia Electric Railway Company Increases Plant.—The British Columbia Electric Railway Company of Vancouver, which supplies light and power to that city and other places in the province as well as exporting energy to Blaine and Sumas, Wash., has in accordance with its preannounced program, spent or is still to spend about $5,000,000 during the present year on power-plant extensions and equipment. At its Stave Falls plant a fifth generator is being installed, and the four existing generators are being rewound, increasing the capacity of the plant from 32,000 kw. to 55,000 kw., this increase of output being made possible by the increased head of the water since the dam was raised. The cost of this work will be about $1,000,000. For the additional plant on the Alouette Lake, near Stave Lake, about $750,000 is being spent in 1924, and $385,000 will be added in 1925 to complete the development. This power plant, which will be situated at the mouth of a tunnel between Alouette Lake and Stave Lake, will generate 9,000 kw. The company recently completed its second 60,000-volt line between Jordan River and Victoria, on Vancouver Island, covering 25 miles and assuring continuity of service.

Rehabilitation Planned for Cleveland City Lighting Plant.—Rumors in a Cleveland newspaper that the city lighting plant was to be offered for sale to the Cleveland Electric Illuminating Company were followed by a statement from Harold Wright, public utilities director for the city, to the effect that approval has been given to the plans of his bureau for the improvement of the city plant by the expenditure of $1,500,000. This amount, Mr. Wright said, would raise the generating capacity of the station to 50,000 kw. and provide proper transmission and distribution facilities. The present capacity is about 35,000 kw. It was at first proposed by A. B. Roberts, who in conjunction with the Municipal Research Bureau, made the criticisms of the city plant that were printed in the ELECTRICAL WORLD for August 30 (page 430), to spend a sum amounting to $2,961,000, but, owing in part to the conservative advice of the Cleveland Engineering Society, which, at the request of the city authorities, reported on the plans, the less costly program was adopted. The committee of the engineering society which investigated the matter consisted of W. R. Abbott, chairman; L. P. Crecelius, R. H. Danforth and J. H. Herron.

Men of the Industry

Joseph Rocchetti, who for the last two and a half years has been power commissioner for Manitoba, Canada, resigned recently to open an office as consulting electrical and mechanical engineeer in Winnipeg.

P. F. Henderson has been elected president of the Carolina Light & Power Company, Aiken, S. C., which was recently acquired by the J. G. White Management Corporation, New York. Mr. Henderson is also a director of the Carolina company.

C. L. Dunn, formerly new-business manager of the Ohio Public Service Company's property at Mansfield, has been appointed general new-business manager for all the Ohio Public Service properties, with offices in Cleveland.

C. J. Theleen, manager of the Plattsmouth district of the Nebraska Gas & Electric Company for the past two years, has been appointed manager of the company's properties at Norfolk to succeed W. E. McFadden, recently transferred to Omaha.

R. L. Spear, superintendent of power at the Coshocton and New Philadelphia plants of the Ohio Service Company, has been assigned to new duties at the plant of the Twin Branch Power Company in South Bend, Ind. Mr. Spear has been associated with the Ohio Service for about thirteen years.

Jerome Blaisdell, formerly of the engineering department and district engineer for the Alma district of the Consumers Power Company, has resigned to become distribution engineer for the Indiana Power Company, with headquarters at Vincennes, Ind.

A. E. Holloway, superintendent of the commercial department of the San Diego Consolidated Gas & Electric Company, has been elected president of the San Diego Chamber of Commerce. Mr. Holloway has always been active in local civic affairs as well as in electrical circles.

C. E. Ewen, for the last four years associated with the People's Power Company of Moline, Ill., has been appointed manager of the Muscatine (Iowa) Lighting Company to succeed T. L. Fisher, who has assumed new duties in Davenport. Mr. Ewen is a graduate of Iowa State University.

Lawrence W. Wallace of Washington, executive secretary of the American Engineering Council, is making a month's speaking tour of the South and West. Addressing local engineering societies in many cities, Mr. Wallace will interpret the aims of the council, stressing the movement to establish a National Department of Public Works.

Walter M. Bird, formerly manager of the Keokuk (Iowa) Electric Company, has been appointed manager of the Paducah (Ky.) Electric Company and the Paducah Railway Company, succeeding Alfred S. Nichols, who is now manager of the Jamaica Public Service Company, Ltd., Kingston, Jamaica. Previous to his association with the Keokuk utility, Mr. Bird was manager of the Fort Madison (Iowa) Electric Company. All these properties are under the executive management of Stone & Webster, Inc., Boston.

R. G. Boyles Receives Promotion

Ralph G. Boyles, until recently assistant superintendent of distribution of the Southern California Edison Company, has been made superintendent of distribution in charge of both overhead and underground distribution lines. Mr. Boyles entered the employ of the Edison company in 1906, directly after leaving the University of Montana, where he studied electrical engineering. After serving in various capacities he was appointed superintendent of the Long Beach district in 1922. Subsequently he was made division superintendent of the Coast division. From this position he was advanced to assistant superintendent of distribution, which position he held at the time of his recent promotion.

R. G. BOYLES

C. C. Moler, formerly superintendent of the Winchester (Va.) territory of the Potomac-Edison Company, has been transferred to Hagerstown, Md., to serve as distribution engineer.

Fred E. Chapman, formerly assistant engineer of the Bangor (Me.) Railway & Electric Company, has recently been appointed assistant engineer of the Carolina Power & Light Company, Raleigh, N. C.

G. E. Orley has resigned as assistant electrical engineer of the New York-New Jersey Bridges and Tunnel Commission to become electrical designing engineer with the Public Service Production Company of New Jersey.

Maurice R. Scharff, who has been valuation engineer of the Philadelphia Company, Pittsburgh, since 1921, has recently been appointed production and valuation engineer of the company. For nine years previous to his association with the Philadelphia Company, Mr. Scharff was affiliated with Morris Knowles, Inc., as assistant engineer, assistant chief engineer and vice-president, during this period devoting considerable time to the valuation, design and construction of public utilities. He is a native of Natchez, Miss., and a graduate of the Massachusetts Institute of Technology.

R. A. Becker, formerly engaged in the consulting engineering business at Glenwood Springs, Col., has been appointed general superintendent to take charge of construction, operation and maintenance of the public service properties of the Beloit (Wis.) Water, Gas & Electric Company.

Obituary

Edward B. Conklin, assistant superintendent of the service and repair department of the Commonwealth Edison Company, died on November 20, following an illness of three weeks. Mr. Conklin was a member of the Edison "Old Guard," having received his thirty-year service pin about six months ago. He entered the company service in May, 1894, as a repairman in the service and repair department. Prior to being made general foreman in 1912, he occupied a number of other positions, among them that of troubleman and meter setter. He was made assistant superintendent of the department in July, 1918.

Charles E. Norton, president of the Norton Electrical Instrument Company of Manchester, Conn., died at his home in that city November 24. Mr. Norton was born in Marlborough, Conn., in 1862, subsequently going to Manchester, where as a young man he worked with William A. Anthony, an expert and inventor of electrical instruments. The Mather Electric Company was then operating in Manchester, and Mr. Norton broadened his electrical knowledge there. When the Mather Electric Company suspended operations he established the Norton Electrical Instrument Company, which engaged in the production of fine electrical instruments.

Ten Broeck Williamson Stinson, consulting mechanical engineer of the Public Service Production Company, engineers and constructors, Newark, N. J., died in the Jersey City Hospital on November 26, as the result of an operation performed a week previous. Mr. Stinson was born September 24, 1889, in New Jersey, and completed the mechanical engineering course at the Stevens Institute of Technology in 1912, entering at once the engineering department of the Public Service Electric Company. In 1920 he was appointed mechanical engineer in charge of designs for the extension and improvements then being carried on by that company. When the Public Service Production Company was formed in February, 1922, Mr. Stinson became consulting mechanical engineer, and he was in responsible charge of all mechanical and building designs for the company until the time of his death. Mr. Stinson was a member of the N.E.L.A. and the A.S.M.E.

Commission Rulings

Securities Must Not Exceed Value of Property.—Fixing the exchange value of utility properties at approximately an amount deduced by averaging estimated reproduction costs less accrued depreciation and then adding 15 per cent to cover construction overheads and 10 per cent to cover intangible value, this value being checked by a computation based upon the capitalization of earnings, the Missouri Public Service Commission refused authorization to the Public Service Company of Missouri to issue certain securities in connection with the acquisition of other utility properties. The addition of 20 to 35 per cent to the cost of reproduction new less depreciation to cover going value was declared excessive, and the principle was laid down that a public utility should not be authorized to issue securities in excess of the value of its property.

Commission Condemns Careless Management of Municipal Plant.—The Greenfield (Ind.) municipal electric plant recently came in for criticism from the Indiana Public Service Commission, which said that the evidence showed that records had been neglected and little or no effort made to preserve a proper accounting system, that the business affairs of the plant were far from efficiently managed, that no records of coal consumed were maintained, that coal had been sold at retail on the partial-payment plan to individuals and notations found among the unpaid bills, indicating that due care was not being taken to account for all the coal sold; that there was laxity in enforcing collections, that haphazard methods controlled the receiving of bids and letting of contracts for improvements, and, in general, that the officials charged with the control and management of the plant had displayed laxity and carelessness. A municipal electric plant is the property of the tax-paying public, the commission remarked, and should be operated in an efficient manner for the best interests of all concerned, and a failure so to operate a plant is a dereliction of duty by those in charge.

Conservation of Plant Capacity.—In deprecating the furnishing by the Idaho Power Company of service at a price less than its ultimate cost, the Idaho Public Service Commission said that the possibilities of additional low-priced water-power developments in the district served by the utility in western Idaho and eastern Oregon are practically exhausted. Unless some alternative be adopted, the users of electrical energy will require higher-priced plant units for their service, with the naturally inferred consequences of higher rates. The commission dwelt on the alternative of restriction of wasteful use of energy and of conserving the plant capacity now installed and listed the following available methods of conservation: (1) Pending the development of a winter peak requiring plant in excess of the summer needs, restriction of further development of irrigation pumping, except at regular power rates, and rotation of use, when necessary, by irrigation power users, within the limits of practicability as later developed; (2) the immediate release of unnecessarily duplicated plant capacity where both cooking and water-heating service have been supplied, by requiring that such service be alternated; (3) metering of all water-heating and air-heating service, with conservation of heat by a heat-insulating covering for the hot-water tank. Service for water heating, the commission held, must not further continue as an uneconomic burden for the other users of electric service to carry.

Recent Court Decisions

Owners of Dominant Heritage Have Right to Unobstructed Flow of Water.—In Deterding vs. Central Illinois Public Service Company, the plaintiff sued for a mandatory injunction to require the company to remove a dam it had built on the South Fork of the Sangamon River on property further down the stream from the site of the plaintiff's farm, thereby backing up the water and causing frequent overflows on the land of the plaintiff, which was the dominant heritage and had by law the right to the natural flow of water without interference because of any obstruction built by the owner of a servient heritage. The company, which built the dam to insure storage water for an electric plant, contended that its dam, which extended only to within four and a half feet of the top of the banks of the stream, had not damaged the plaintiff's property and that, even if it had, the injury to the defendant in granting the injunction would be so much greater than the injury to the plaintiff in refusing it that the court should deny the relief sought and the case should be sent to the Illinois Commerce Commission for adjustment. The Supreme Court of Illinois sustained the lower court's finding for plaintiff and gave the company six months in which to remove the dam. (145 N.E. 184.)*

Injunction Against Competitor Refused to Power Company in Case Not Taken to Commission.—The Seneca River Power Company furnishes electrical energy in certain towns and villages in New York State and also supplies energy to other lighting companies. In 1910, without the approval of the Public Service Commission, it built a substation in the city of Fulton, in which it has no franchise to operate, on land owned by it and thereafter furnished electricity to a paper mill in the city and to five private persons. In doing so it crossed no public property but ran its lines entirely over property which it owns or has acquired the right to use. The Fulton Light, Heat & Power Company, which has a franchise in Fulton for distributing electricity, brought action for an injunction to restrain the Seneca company from maintaining its Fulton plant without a franchise and to compel it to remove its equipment. The New York Supreme Court has refused to issue the injunction, holding that the complaining company should before coming into the courts have sought a remedy from the Public Service Commission. The point emphasized by the court was that an electrical corporation has no inherent right to the monopoly of a territory such as it can call upon the courts to enforce without first applying to the body set up by the state to adjudicate such disputes when they arise. (205 N. Y. S. 821.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Taxation of Electric Utility Property Situated in Two Towns.—The Connecticut Supreme Court of Errors has held, in voiding an assessment for taxes made by the town of Oxford and appealed against by the Connecticut Light & Power Company, that where a dam belonging to a power company is partly in one town and partly in another it is taxable only in the town where the power is produced, though the land on which it stands may be taxed by the other town. Similarly, transmission towers are taxable only as part of the machinery of power production in the town where the power is generated and used. As regards the other town, they rank neither as real nor as personal property subject to taxation. (126 At. 1.)

Discrimination Against the Coatless!—An unusual complaint was made to the Oklahoma Corporation Commission when the Atchison, Topeka & Santa Fé Railway Company was charged with discrimination because the lessee of its restaurants refused to serve coatless patrons at the tables though admitting them to the lunch counters. The commission found discrimination to exist, but the Supreme Court of Oklahoma has reversed this finding and laid down the following principle applying to all utility companies: "While much power is by law given to the Corporation Commission in the regulation of public utilities, yet the utility is not the property of the commission or the state, but belongs to the company and its stockholders, and the officers and directors by them selected must, under proper regulation, be permitted to manage the property in such proper way as to earn and pay, if they lawfully can, just dividends to the stockholders. Regulation must not be so far extended as to constitute management or operation. A public utility has the right to prescribe and enforce reasonable rules and regulations for the government and use of its property, and no such rule should be abrogated by the Corporation Commission, unless it is contrary to the law of the state, or is clearly proved to be unjustly and injuriously discriminatory, or is so arbitrary and unreasonable as to be decidedly unjust to its patrons. A rule that is made applicable equally to all and with which all can comply with equal ease is not discriminatory." (229 Pac. 428.)

Manufacturing and Markets

Non-Ferrous Metals

Manufacturers, Refiners and Producers Request Government to Investigate World Reserves

INCREASING concern is being evidenced as to future supplies of the major non-ferrous metals. The consuming industries, in particular, are anxious that the federal government undertake the gathering of data which will permit more accurate estimates of the world reserve of lead, tin, copper and zinc. It is admitted by the government's non-ferrous specialists that existing figures as to world reserves of these metals are little more than guesses. In fact, none too abundant information is available as to unmined domestic deposits.

A large manufacturer of electrical equipment has just inquired if an investigation of this sort does not come within the province of the federal government. It is pointed out that this is a type of survey which cannot be undertaken by private interests. While it is admitted that information along this line would be very valuable to consumers of copper and other non-ferrous metals, the public generally would be benefited sufficiently, it was thought, to justify the expenditure of taxpayers' money in such an activity. This inquiry supplements similar suggestions that have come from refining and producing interests. The consensus of opinion seems to be that the government is in a better position to undertake the gathering of such information in foreign countries, although the idea is that substantial co-operation would be furnished by interested trade associations and technical societies.

The information needed most urgently is in respect to lead. While the shortage of that metal has been in evidence for a long time, there still is great uncertainty as to the output which may be brought out by the higher level of prices. Spain is known to possess considerable potentialities for lead production, and there is a demand for information just at this time as to the price level which will stimulate the development of this Spanish resource. This particular question is being investigated by one of the government agencies at this time. It is believed, however, that there are other sources of lead which the government's far-flung personnel could ferret out and thus be instrumental in bringing them to the attention of those who might be interested in prospecting them. The possibilities for greatly increased consumption of copper have caused some uneasiness, even in connection with supplies of that metal. It is believed, however, that there is less cause for concern about world resources of copper than of any other of the metals mentioned.

Taxation a Big Problem, Says General Falk

"GOOD business may be expected during the coming year if we can maintain our position in the agricultural field and if Congress will enact sane legislation," says General Otto H. Falk, president of the Allis-Chalmers Manufacturing Company. "Taxation, which has a large bearing on the prosperity of the country, is a big problem that Congress must face. Also, inheritance taxes are now so high in many states that men hesitate to put their money into new enterprises on that account. Fundamentally, however, the country is on a sound basis, and I am confident that we may expect a continuous growth of the demand for electrical apparatus."

Power Show Review

Much New and Improved Apparatus Reflected in the Exhibits—Three Hundred and Seventy Manufacturers Display Their Products

EXHIBITS at the Third National Exposition of Power and Mechanical Engineering, which was held last week at the Grand Central Palace, New York, showed that at the present rate of engineering advance even a single year brings its flood of new and improved apparatus. Last year 260 manufacturers exhibited their products, whereas this year the number increased to 370.

In every line progress was shown. The refractory manufacturers displayed new types of furnace-wall construction and improved refractories to meet more strenuous operating conditions. Power-plant instruments showed a marked development, particularly apparatus for gas analysis and combustion control. A wide variety of boiler-room instruments were on display, some new, others remodeled to give more effective service or to give sufficiently accurate results at a lower cost, and still others varying in the mounting, a noticeable feature being the general adoption by nearly all builders of the flush-type meter. During the year many of the manufacturers had added to their respective lines, so that an instrument or meter for almost every conceivable function was to be seen at the show.

Motor-operated valves, already well represented last year, were present in increased variety with many improved features both in the valve unit itself and in methods of control. Much more attention was given to such relatively new devices as air preheaters and generator-air coolers. Distinct progress was also manifest in the design and construction of such auxiliaries as evaporators, pumps, heaters, etc.

High-Pressure Valves a Feature

The number, size and variety of high-pressure valves exhibited this year was an impressive feature of the show. Many valves, for pressures around 600 lb. and temperatures ranging upward from 750 deg. F., were exhibited this year, as against only a few such last year—and those mainly presented as something sensationally new. One large valve on exhibition will immediately be placed in oil-still service at 500-600 lb. pressure and 1,000 deg. F. temperature. Another was designed for service at 1,200 deg. The trend toward much higher pressures was also reflected in exhibits of high-pressure traps and other draining

devices, feed-water regulators, piping, etc. Many developments and improvements have also been made in pulverized-coal equipment. Of the six unit-type pulverizers on exhibit two were shown for the first time.

The exhibits of oil-burning equipment of both the steam and mechanical atomizing type were very complete. Many were shown in operation, spraying water in a glass case, thus affording the opportunity of demonstrating the atomizing properties of the burners. A new type of burner in which an artificial or natural gas burner is combined with a mechanical atomizing oil burner was also shown.

Many working models were exhibited, glass sides being used to show internal operation. A greater number of full-sized sections of boilers, economizers, etc., also aroused special interest. A number of small prime movers were displayed, but one of the greatest opportunities for improvement lies in the direction of securing more and larger prime movers for future power shows.

A significant change was revealed at the show in the selling personnel of the industry. Although courtesy and good fellowship still remain a valuable asset, engineers are demanding facts as a basis of choice of equipment, and throughout the industry manufacturers have found it necessary to employ as salesmen engineers prepared to furnish these facts. Such sales engineers, in attendance at almost every booth, were ready and able to demonstrate the essential points of their products in a concise and understandable manner.

A Market Analysis

Manufacturer Should Determine His Markets and Consider Their Relative Importance—Principles that Should Govern His Sales and Advertising Policy

BUYING habits of industry, like all habits, are subject to analysis. They are not intangible. They can be checked and weighed, the same as any other commodity, and, once understood, the method of getting at industrial buying power is simple and direct. In every sale to industry there are four cardinal principles to be followed before the sale is consummated. Each principle represents an essential step in breaking down the barrier of sales resistance surrounding the industrial buyer. These principles are:

1. The worth-while markets must be determined.

2. Buying habits of these markets must be analyzed.

3. Channels of direct approach to the buyers must be selected.

4. The strongest possible appeal to these buyers must be prepared.

When these principles are adhered to and applied to the specific problems of any manufacturer, they automatically result in policies which bring high sales efficiency.

BUYING POWER OF INDUSTRY

To determine how large the industrial market is as a whole one may use the percentage of people engaged in gainful occupations. The various fields in which the workers are employed in America's business structure are shown graphically in Fig. 3. It will be seen that 44.8 per cent of the workers are employed in industry, 26.4 per cent in agriculture, 14.3 per cent in trade, 9.8 per cent in personal service and miscellaneous occupations and 4.7 per cent in professional work. Industry is thus seen to be by far the largest employing division, nearly one-half of all the workers being employed in it. Further, if one considers the combined business activities of the country, which produce a total yearly income of $112,000,000,000 (figures are for the year 1922), it is found that 54.5 per cent is produced by industry—more than half of the business income of the country. The comparison with the income from other sources is shown graphically in Fig. 2. The $61,000,000,000 annual income of industry is larger than the entire private income of the citizens of the country, which was estimated by the Department of Commerce as $50,000,000,000 for the year 1923. The income of industry reflects its extensive use of mechanical equipment by showing a high productivity per worker. The position of American industry today, as the leading world producing group, has been gained almost exclusively by the application of mechanical methods to increase the limited production possible by hand work. Looking into the future, with par-

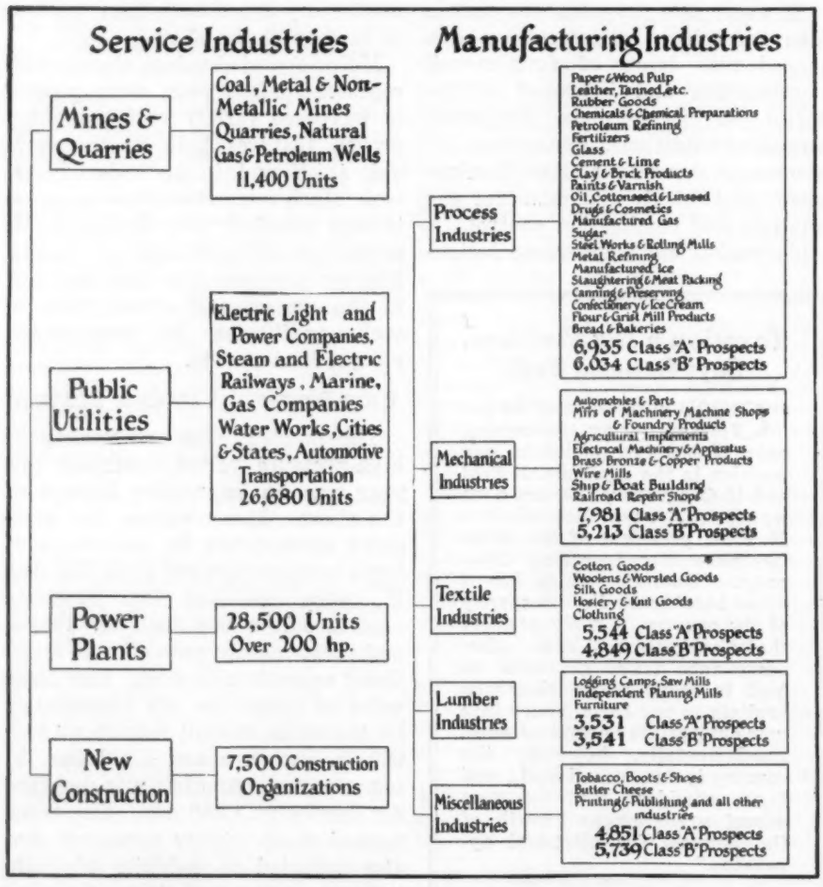


FIG. 1—THE BUYING STRUCTURE OF INDUSTRY WITH THE NUMBER OF WORTH-WHILE PROSPECTS IN EACH CLASS

ticular regard to our present restrictions on immigration, the path of industrial progress is obvious. American industry must go forward as never before through increased and more efficient "machine" applications.

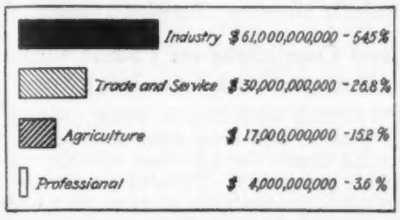


FIG. 2—WHERE THE INCOME IS PRODUCED IN AMERICA'S BUSINESS STRUCTURE

What is this great structure of industry represented by 18,673,000 workers and $61,000,000,000 of income? How is this structure divided and concentrated? The answers to these questions are essential to enable the manufacturer with a definite sales problem to pick out the particular sections of industry that form economic groups for the sale of his equipment and thus bring his sales strategy to bear with full force upon his real markets. The structure of industry as a whole is composed of certain definite divisions all of which may be segregated and analyzed. With a proper working knowledge of these divisions the manufacturer can plan his market structure with assurance and avoid the wasteful policy of scattering, which has proved the downfall of many sales campaigns.

Briefly, industry is composed of two basic groups, service industries and manufacturing industries, and these two groups have nine major divisions, as shown in Fig. 1. Industrial markets for most products follow the major group classifications rather than the restrictions of a single industry. However, the nine major divisions of the industrial market may easily be subdivided to determine the exact number of "prospects" in any single industry.

CAUTIONS TO BE OBSERVED

In building his market structure the manufacturer must of course guard against the temptation of reaching out for the small marginal business that is worth while neither from the standpoint of individual sales nor from that of collective volume. For example, a manufacturer upon actual analysis of his prospects in industry may find that 90 per cent of his sales possibilities lie in eight particular fields. The necessity for careful analysis before building the market structure is, therefore, apparent. It is interesting to note that the present successful leaders in most lines of industrial equipment have refused to be blinded by scattered border-line business. These leaders have determined their profitable markets and have built a commanding sales and service position in these, one by one, as their plant capacity expanded. Once the manufacturer has determined his profitable market and has located the buyers, he must decide how best to extend and back up his sales by influencing these buyers through advertising.

The manufacturer must, therefore, apply the four cardinal principles if he is to get full return from his sales dollar. The first essential step—the determination of the worth-while markets—is a clean-cut application of definite market analysis. Industry, despite its great ramifications, can be classified with exactness and its profitable markets segregated for any product. When the manufacturer determines these markets and considers their relative importance, he will next bring facts to bear to ascertain which men control the buying. In other words, he will establish his buyers. Third, in putting the influence of advertising behind his sales force to extend his markets and break down the barriers of sales resistance the manufacturer will select the direct channels of approach to his buyers. Finally, he will develop as his sales and advertising policy the appeals that will tie his product directly to the production problem of each of his fields. He will thus win recognition for his organization as a specialist in the industries he selects. When the manufacturer has established his sales promotion on these principles, he is obviously attacking his markets with the guarantee of high efficiency in sales and advertising effort. He is cutting directly through the area of sales resistance that surrounds the industrial buyer.

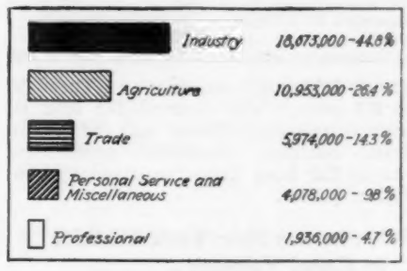

Industry 18,673,000 - 44.8%
Agriculture 10,953,000 - 26.4%
Trade 5,974,000 - 14.3%
Personal Service and Miscellaneous 4,078,000 - 9.8%
Professional 1,936,000 - 4.7%

FIG. 3—WHERE WORKERS ARE EMPLOYED IN AMERICA'S BUSINESS STRUCTURE

Business Conditions

GENERALLY good business is being transacted in the electrical industry, although sales of apparatus are somewhat quieter—a usual year-end condition. However, a number of new inquiries in manufacturers' hands, a renewal of negotiations covering former projects and the knowledge of the large amount of work scheduled by the central-station industry are indicative of good business next year, and one large manufacturer believes that a considerable number of orders will be closed in January and February.

The report of the United States Steel Corporation indicates the continued growth of the country's business as a whole. There was a gain in unfilled orders of 506,000 tons during November—the largest gain in any month in more than two years. Elbert H. Gary, chairman of the directors of the company, says that the increase is gratifying but should cause no surprise, as business generally is good and is growing better. Building permits in November for the country showed a falling off as compared with last year and a decrease of about 16 per cent under October.

In New England trade is steady, but apparatus sales are quieter with very good prospects for business next year. The volume of business is good in the New York district, and many inquiries are being received by manufacturers that should be acted on early next year. In the Southeast industrial conditions are improving and sales are satisfactory. Good equipment sales have been made in the Middle West and business is active. On the Pacific Coast trade is improving. Crop conditions in this section also presage good sales next year.

Lead Prices Advance in an Otherwise Firm Market

THE leading producers of lead increased their prices this week after having maintained them at the same level for several weeks. Zinc and copper had a slight reaction but went back to their former prices in the last day or two, with a renewal of strength in the London market. Sales of copper have been less, but prices are substantially unaffected as producers are selling more than they are making. The foreign demand has been very satisfactory.

A not unexpected advance in the price of lead was made by the American Smelting & Refining Company on Mon-

NEW YORK METAL MARKET PRICES

	Dec. 3, 1924 Cents per Pound	Dec. 10, 1924 Cents per Pound
Copper, electrolytic	14⅛	14⅛
Lead, Am. S. & R. price	8.65	8.90
Antimony	14⅛	14⅛
Nickel, ingot	29–30	29½
Zinc, spot	7.40	7.40
Tin, Straits	55	55
Aluminum, 98 to 99 per cent	28	28

day to 8.75 cents and again on Tuesday to 8.9 cents. The demand for lead is well distributed among all the usual trade outlets. Domestic production has so far been little increased by the higher prices.

Sales in the New York District in Good Volume

SALES in the New York district are in good volume, the recent improvement being maintained, though somewhat tempered by the slight lull usually noticed in December. However, many inquiries are in the hands of manufacturers, so that a considerable amount of business is expected to be closed in the early months of next year. Several central-station companies also have work in mind that will require much material.

Industrial lighting equipment sales have been very good, and many sales of appliances are being made to meet the holiday trade. Late last week an order was closed by a holding company in Chicago for $35,000 worth of poles, cross-arms, insulators and pole-line hardware for use on the Jersey coast.

Trade in New England Steady—Apparatus Sales Quieter

APPARATUS sales are a little quieter for the moment in the New England district, but it is believed that some inquiries are being held back pending the determination of 1925 budgets. Burlington (Vt.) recently purchased a second-hand steam-turbine set, and some of the hydro-electric possibilities of western New England are being more actively studied, with the reasonable likelihood of early development. In Boston successful trial installations of electric traffic signals are expected to result in substantial expenditures in this field. Thus far the open season has enabled many public utilities to keep up their line work, and as a result orders for line material have held up remarkably well.

Sales of electrical supplies continue steady, and a good business is being handled in seasonal products. Washers and portable lamps are also moving in large volume. Household fixtures are in better demand, and an increasing interest in automatic substations is also reported by manufacturers' branch offices.

Good Equipment Sales in the Middle West—Business Active

BUSINESS in the Middle West remains good, and the volume of business apparently is increasing. Central-station construction continues active and varied plans for expansion are being outlined at the present time. With the exception of one order for a large amount of turbine repair parts no exceptionally large orders have been placed this week. However, a multitude of smaller orders helped to swell the volume of business. The following items were among the smaller orders received: One 17,000-amp. and three 13,000-amp. synchronous converters, eighty-four solenoid-operated 600-amp. and 800-amp. circuit breakers, one order for 600 Thompson meters and another for fifty 5,000-amp. D.P.D.T. switches.

Cross-arms were much in demand, and a number of orders were placed before the 5 per cent increase in price announced last week went into effect. An order for about $125,000 worth of electric vehicles was also received by one manufacturer this week. Jobbers report good business in most lines. Most commodities are moving well, particularly wire and conduit and electrical appliances.

Industrial Conditions Improve in Southeast—Sales Satisfactory

BUSINESS generally throughout the Southeast for the past week has been quite satisfactory. Industrial conditions show considerable improvement, with cotton-oil mills in better shape than for several seasons past, and all textile-mill operations are again on a normal basis. Central-station expansion continues, and one jobber reports the receipt of a partial order for line materials which in the aggregate will amount to approximately $50,000 when complete orders for the job are in hand.

A number of industrial jobs which have been in prospect for several months past have materialized, and prospects are for the electrification of textile mills with an aggregate of 20,000 hp. between now and early spring. A brisk movement is reported in electrical construction materials, and the demand for commercial lighting fixtures is very good. Street-lighting equipment sales have picked up again, and fairly satisfactory orders have been received during the past week or ten days. Retail business as a whole is very good, with all lines active, particularly all types of socket appliances.

Crop Conditions on Pacific Coast Presage Good Sales Next Year

SPECIAL attention is being paid to general and crop conditions on the Pacific Coast, for on these will depend urban prosperity. Present predictions are that the business of next year will be very good. Crop tonnage is far below normal, but is offset by prevailing high prices. The canning industry is exceedingly prosperous, and canning companies are buying much electrical equipment. Retail buying is increasing, but is below last year's figures. Rigid iron conduit shows about a 15 per cent increase over last year's sales and the larger sizes are reported to be out of stock. A 5 per cent increase in 600-volt and 2,500-volt lead wires and cables has been announced.

The city of Tacoma will request bids next week for construction of the proposed Lake Cushman substation, the Tacoma terminal of all transmission lines from the 140,000-hp. hydro-electric project being built in Mason County for the Tacoma lighting department. When completed and equipped, the building is estimated to cost $550,000. Contracts approximating $65,000 have been awarded by the city of Tacoma on the Cushman project. All bids for wired-wireless telephone equipment were rejected as excessive.

Activities of the Trade

Nehring Electrical Works Expands Plant Facilities

The Nehring Electrical Works, De Kalb, Ill., in March of this year purchased about two acres of land from the Superior Machine Company, situated on the Chicago & Northwestern Railroad and only three blocks away from the original Nehring plant. A modern three-story brick building which was on the property has been considerably improved and made over to suit the conditions necessary for the installation of an insulating plant to manufacture weatherproof copper wire and cable. This plant will soon be placed in operation as the second unit of the Nehring company in De Kalb. The combined output of both plants will be approximately 1,000,000 lb. a month of weatherproof copper wire and cable. The general offices of the company have been moved from plant No. 1, at Lincoln Highway and Sixth Street, to its new building at Locust and Ninth Streets.

In July of this year the Nehring Electrical Works also purchased the entire plant of the Cleveland Wire & Cable Company, Cleveland, all of which has been moved to De Kalb and installed in the new building, and considerable additional new machinery and equipment was purchased for installation there. The company has also recently closed two large contracts with two railroads, one contract totaling over 1,000 miles of weatherproof wire

R. Thomas & Sons Company Holds Annual Sales Conference

The annual conference of sales executives was held at the R. Thomas & Sons Company's headquarters at East Liverpool, Ohio, early this month. The program was arranged to cover three days. The first day was devoted to the subject of production. Many newly developed processes were explained and demonstrated and followed up by a trip through the completely remodeled Lisbon (Ohio) plant.

The second day was spent in analyzing trade experiences of the past year and offering recommendations for the

future. New types of insulators were discussed and a special brief course on "insulator testing" was given. The next session was devoted to the commercial side of the business. An elaborate comparison with the business of previous years showed that a perceptible gain was made in the volume of domestic business and a decided increase in exports despite the reconstruction work at the Lisbon plant and the general lull in industrial activities. According to tentative figures disclosed, there was only about a 2 per cent gain in the sale of pin-type insulators over 1923 (which had been above average), while a gain of 15 per cent was noted against average figures. Suspension insulator sales especially showed great improvement, recording a gain of 22 per cent over 1923, which was nearly 50 per cent above the average. The conference closed with a banquet at which addresses were made by G. R. Thomas, vice-president; J. E. Way, sales manager; H. R. Holmes, general manager; G. E. Eckert, manager of the publicity department; A. G. Mason manager of the Lisbon plant; H. J. Billica, Seattle, and J. C. Crilly, San Francisco.

American Electric Switch Announces Organization Changes

The American Electric Switch Company, Minerva, Ohio, manufacturer of electric switches, announces that it has recently made a change in the personnel of the company. J. C. Lewis is president and general manager, and F. J. Cope is sales manager. Keeley R. Miller is auditor of the company and has full charge of the credits. The company states that its sales policy is a strict jobbers' policy, and direct representation is obtained through manufacturers' agents located in various territories.

The agents selected are those who will do the proper missionary work and cooperate with the recognized jobbers in their various territories. At the present time the company maintains sales organizations in various cities.

Fairbanks-Morse Holds Sales Convention and Inspects Works

New products, sales plans and production methods of Fairbanks, Morse & Company were studied during the course of a sales convention and inspection trip of the twenty-eight branch managers and factory and general office executives which was held last week at Chicago. Using special cars, the party also inspected the electrical machinery plant at Indianapolis, the pump factory at Three Rivers, Mich., and the engine plant at Beloit, Wis.

In reviewing the history and future plans of the organization, W. S. Hovey, vice-president and general manager, in his address at Chicago, stated that the outlook for 1925 is considerably better than it was at the beginning of 1924.

Mr. Hovey told about the organization growth of Fairbanks, Morse & Company since the date of establishment in 1865 and discussed the various steps leading to the consolidation of the five factories with the sales houses into one unified organization. At Indianapolis the party had an opportunity to see the production methods used in turning out electrical machinery. A. W. Thompson, general manager of the plant, said that 75 per cent of the motors now produced by the company are equipped with ball bearings.

Chandeysson Electric Builds First Unit of New Plant

The first unit of the new one-hundred-and-seventy-five-thousand-dollar three-story, reinforced concrete addition to the Chandeysson Electric Company's plant at St. Louis is nearing completion. The company manufactures motors and generators. The addition, when completed, will be 360 ft. long, 52 ft. wide and 50 ft. high. It is equipped with a 30-ton crane and served by a spur of the Missouri Pacific Railroad which enters the center of the building.

Altorfer Brothers Erect Unusual Illuminated Sign

A big illuminated sign containing within it a display of the products of its manufacture, as shown in the illustration, has recently been erected by the Altorfer Brothers Company near its works at Peoria, Ill. The sign is so placed that passing motor and streetcar traffic can see it plainly and is a new idea in signs that work both day and night. It is a regulation signboard 50 ft. long and 20 ft. high. In the center of the board a show window of glass has been installed, and in a room back of this glass front several different kinds of washing and ironing machines are displayed. The display case is also illuminated by means of concealed lights.

COMBINATION ILLUMINATED SIGN AND DISPLAY SHOWCASE

The machines on exhibit are virtually only shells as all inside parts, such as motor, gear cases and so on, have been removed. Thus if any one should feel inclined to cart off the different models he would not even be repaid for his trouble.

Howell Electric Motors Equipped with Tapered Roller Bearings

The Howell Electric Motor Company, Howell, Mich., is now furnishing its "Red Band" motors equipped with tapered roller bearings. The company announces that "Red Band" motors can still be obtained with Howell patented recentering bearings, if they are desired.

Link-Belt Erects New Warehouse at Detroit

To cope with the greatly increased demand for Link-Belt products and to give better close-range service, the Link-Belt Company has erected a new warehouse and office building at 5938 Linsdale Avenue, Detroit. The new structure is two stories high and houses not only the general office for the Detroit branch but a large warehouse where standard Link-Belt and H. W. Caldwell & Son Company products are kept in readiness for immediate shipment.

The stock includes various types of chains for elevating, conveying and power-transmission purposes, clutches, etc.

Westinghouse Receives Two Orders Totaling $500,000

Two orders for power-plant equipment totaling approximately $500,000 have just been awarded the Westinghouse Electric & Manufacturing Company by the Philadelphia Electric Company and the United Electric Light & Power Company of New York. The contract with the Philadelphia company calls for a 70,000-sq.ft. condenser to serve the 50,000-kw. turbine in the power plant of the Richmond station. This condenser will probably be the largest physically that has ever been manufactured. The order also includes two 78,000-g.p.m. motor-driven circulating pumps, two Le Blanc air pumps and two condensate pumps, also motor-driven.

The order received from the United Electric Light & Power Company is for one 65,000-sq.ft. condenser, which will serve the 50,000-kw. turbine of the Hell Gate power plant. Other equipment includes two 38,000-g.p.m. circulating pumps, two condensate pumps and steam-jet ejectors for air removal.

F. W. Wakefield Not Seriously Handicapped by Recent Fire

A fire which on December 5 almost destroyed the main factory building of the F. W. Wakefield Brass Company at Vermillion, Ohio, it is reported, will not seriously cripple the company's service to its trade. The warehouses in which were stored considerable stocks of "Red Spot" lighting material and parts were uninjured, the administration building with books and records was only slightly damaged by smoke, and the tools and machinery proved to be in such state that they will be recon-

ditioned by the time a new building is ready to receive them.

The new factory, already ordered, will be almost double the size of the old building, according to A. F. Wakefield, vice-president. It will be of standard type and is expected to be finished within six weeks after the fire. In the meantime assembly operations, finishing, toolmaking and certain of the lighter manufacturing operations will be carried on in the warehouses and in rented space.

The A. J. Lindemann & Hoverson Company, Milwaukee, announces that it is now prepared to furnish its "L. & H." electric ranges with an automatic time and temperature control.

The General Electric Company has received an order from the Narragansett Lighting Company for a 35,000-kw. turbo-generator set with direct-connected exciter.

The National Council of Lighting Fixture Manufacturers, 424 Cleveland Discount Building, Cleveland, announces that H. B. Garrett has been appointed secretary to succeed Charles H. Hofrichter. The executive board in making the announcement says that it felt Mr. Hofrichter should be permitted to take care of his personal business interests, which have been neglected on account of his association activities during the past five years. Mr. Hofrichter was elected honorary secretary of the association so that the National Council might have the benefit of his counsel and advice throughout the ensuing year.

The Jefferson Electric Manufacturing Company, 403 South Green Street, Chicago, manufacturer of electrical specialties, has leased a four-story-and-basement building at Green and Congress Streets, 112 ft. x 115 ft., to be used for manufacturing purposes.

The P. A. Geier Company, Cleveland, manufacturer of "Royal" electric cleaners, announces a "prosperity sales contest" beginning January 4, 1925. Prizes aggregating $5,000 are offered.

The Dubilier Condenser & Radio Corporation, 48 West Fourth Street, New York, has acquired a new manufacturing unit at 238th Street and Bronx Boulevard, New York City, and will gradually move its productive equipment to the new quarters. Contemplated additions will about triple the present plant capacity. Current business of the company, it is estimated, will show an increase of more than 300 per cent over that of the corresponding period of last year.

The Universal Crane Company, Elyria, Ohio, has found it necessary to increase the size of its general offices in Cleveland owing to the growth of its business in the last few years. The company has, therefore, moved from 1106 Swetland Building to new quarters at 914 Swetland Building.

The Oklahoma Armature Repair Company, Tulsa, Okla., has recently been incorporated by P. K. Minck, president and general manager of the Oklahoma High Line Construction Company. A new building has been leased to house the two companies in a downtown location.

The Matthews Engineering Company, Sandusky, Ohio, was recently declared bankrupt, and its plant and equipment are offered for public sale by the receiver, M. C. Cosgray. The company formerly manufactured farm and small industrial lighting plants.

The H. P. Dodge Engineering Company, Jackson and Thirteenth Streets, Toledo, Ohio, manufacturer of electric batteries and battery equipment, has awarded a contract for the erection of a two-story brick factory, to cost $45,000, exclusive of equipment.

The Globe Electric Works, San Francisco, manufacturer of electrical specialties, has filed plans for the erection of a new plant at Fifteenth and Mission Streets, to cost $45,000, including machinery and equipment.

The Jacobson Engineering Company, consulting engineers specializing in the design and supervision of construction of hydro-electric power developments, and pulp and paper mills, announces the removal of its offices to suite 461 Northwestern National Life Insurance Building, Minneapolis.

New Equipment Available

Combined Gas and Oil Burner

A combined gas and oil burner for power purposes has recently been placed on the market by the Peabody Engineering Corporation, 110 East Forty-second Street, New York. The oil burner and air register are the standard Peabody-Fisher burner and Peabody air register. The gas burner is located between the furnace front and the air register and is so constructed that the gas enters the furnace in a thin, conical sheet. As the air entering through the register is rotating rapidly across the casting forming the face of the gas chamber a very intimate mixture is obtained which results in excellent combustion and maximum efficiency. It will be noted that the design of the burner is such that the change from one fuel to the other may be accomplished with no other mechanical operation than the opening and closing of the proper valves. In fact, it is said to be quite possible to burn both gas and oil simultaneously, a feature which facilitates the rapid change from one fuel to the other.

The construction is such that when oil is being burned all the air for combustion passes over the gas chamber, thereby preventing overheating. The capacity of the gas burner may be varied between 4,000 cu.ft. and 20,000 cu.ft. per burner per hour. The register is built for either forced or natural draft operation.

Pyrometer

A new pyrometer having a very high internal resistance and internally compensated for cold junction correction has been placed on the market by the Republic Flow Meters Company, 2240 Diversey Parkway, Chicago. In addition it is provided with a longer-scale range, and Bakelite moldings and die castings are used wherever possible to obtain interchangeability and accurate assembly. A variable-resistance, 60-ohm rheostat makes it possible to adjust instantly and accurately the instrument for changes made in the external circuit after installation. The instrument is available in either the indicating type or the duplex recording type with scale ranges for every application. The thermocouples furnished with these instruments are provided with weatherproof inclosed heads as standard equipment. This thermocouple head is in three pieces. Two are die castings, and a Bakelite molded insulator, with the element, is held in position when the cover is secured. The head is tapped for flexible conduit.

Furnace-Wall Plastic Sprayer

A portable sprayer for the coating of furnace walls, known as the "Acme," has been developed by the Co-operative Utilities Company, Inc., Philadelphia. The Quigley Furnace Specialties Company, 26 Cortlandt Street, New York, is exclusive sales agent.

The sprayer is designed to handle the standard refractories whenever the nature of the work will allow the use of bonding material and water to form a plastic mass. Air, steam or water may be used to furnish pressure for operating the sprayer. A charge for the machine is about 2½ cu.ft., which is sufficient to cover over 100 sq.ft. with a coat ¼ in. thick. The machine can be carried around the plant on a hand truck, its total weight being about 600 lb.

Safety Switch.—A new type of quick-break switch, designed and built for use as an entrance switch, "disconnect," or for installations demanding infrequent operation, has been announced by the Square D Company of Detroit. The new switch has a single-throw action and is fusible. It is now being built in the 60, 100 and 200-amp., three-pole, 250-volt sizes and is known as the 46,000 line.

Electric Tapper.—A portable electric tapper has been added to the line of portable electric tools manufactured by the Black & Decker Manufacturing Company, Towson, Md. The mechanism in the gear case is so designed that the tap is driven in at a speed of 350 r.p.m., and by a slight backward pull on the machine the tap chuck is automatically reversed and the tap backed out of the threaded hole at double the speed it is driven in. No reversing switch is needed. The tapper will tap holes in steel up to ¼ in., in cast iron up to ⅜ in. and in brass or aluminum up to ⅝ in. The machine weighs 8¾ lb. and is equipped with a "Universal" motor.

New Trade Literature

INDUSTRIAL THERMOMETER. — The Moto Meter Company, Inc., Long Island City, N. Y., has issued catalog No. 3, covering the "Motoco" indicating thermometer. It contains a history of the "Motoco" industrial thermometer. More than 20,000 of these thermometers rendered service on the United States Army and Navy planes during the World War, and many are in use as transformer temperature indicators. Illustrations showing methods of construction and instructions for installing and reading them are included.

TESTING TRANSFORMERS.—Bulletin No. 53 issued by the American Transformer Company, 178 Emmet Street, Newark, N. J., describes its line of testing transformers, including types TS-10 testing set; TS-1 high-voltage testing set; 300,000-volt, 60-cycle testing transformer, etc.

AIR-BREAK SWITCHES.—A new circular picturing and describing a 30-kv. air-break switch has been issued by the Hi-Voltage Equipment Company, Cleveland. A detailed cross-section of the switch is shown with a list of all parts entering its construction. Various features such as strength, leverage, contact, ease of installation and cost are dealt with.

NOVALUX LIGHTING UNITS.—"Pendant & Bracket Novalux" is the title of bulletin No. 43,525, issued by the General Electric Company, Schenectady, N. Y., which describes and illustrates the different types of "Novalux" lighting units of the bracket and pendant types.

FURNACE ARCHES.—The eighth edition of "Detrick Arches" has been issued by the M. H. Detrick Company, 140 South Dearborn Street, Chicago. The booklet shows the adaptability of Detrick arches to all types of boilers and stokers, industrial furnaces and oil stills. A number of typical modern furnace settings using Detrick arches are described and illustrated by drawings and photographs. The "Detrick sectional supported wall," developed originally for powdered fuel service, is presented for the first time in this catalog.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase and agency is desired in Warsaw, Poland (No. 12,442), for electrical equipment.

An agency is desired in Rio de Janeiro, Brazil (No. 12,493), for electrical material and radio supplies.

Purchase and agency is desired in Wellington, New Zealand (No. 12,496), for engineering and general construction equipment, electrical household appliances and lighting, heating and ventilating equipment; No. 12,428, for electric and hand-power vacuum-cleaning and sweeping machines.

An exclusive agency is desired in Brussels, Belgium (No. 12,497), for radio sets and accessories.

Purchase is desired in Ottawa, Canada (No. 12,494), of radio sets and accessories.

Purchase is desired in Torreon, Mexico (No. 12,495), of telephone equipment for a system of from 800 to 1,000 telephones.

Purchase and agency is desired in Bordeaux, France (No. 12,605), for automobile accessories, garage tools and electrical equipment.

An exclusive agency is desired in Auckland, New Zealand (No. 12,500), for electric generators and for motors from 5 hp. to 50 hp.

An agency is desired in the Netherlands and Belgium (No. 12,609) for electric appliances.

Purchase and agency is desired in Bahia, Brazil (No. 12,498), for electrical material.

An agency is desired in Lwow, Poland (No. 12,503), for electrotechnical materials and radio-telephone equipment.

Purchase and agency is desired in Melbourne, Australia (No. 12,505), for lighting equipment.

Purchase is desired in Kovno, Lithuania (No. 12,499), of radio apparatus.

An agency is desired in Lyons, France (No. 12,502), for radio sets and parts.

Purchase or agency is desired in Winnipeg, Canada (No. 12,607), for radio sets and parts.

An agency is desired in Wellington, New Zealand (No. 12,504), for radio sets, parts and batteries.

An exclusive agency is desired in Amsterdam, Netherlands (No. 12,501), for radio transmitting and receiving sets and parts.

Purchase is desired in Montevideo, Uruguay (No. 12,552), of four air compressors.

An agency is desired in Windsor, Canada (No. 12,590), for large refrigeration equipment.

Purchase is desired in Winnipeg, Canada (No. 12525), of hard-rubber jars and covers for batteries.

New Incorporations

THE SHORE LINE ELECTRIC COMPANY, Bangor, Me., has been incorporated with a capital stock of $50,000 to supply electricity to a number of towns in Hancock and Washington Counties. The officers are: Harry L. Wheelden, president; Elwood L. Kimball, treasurer and clerk, both of Bangor.

THE STANDARD POWER & LIGHT COMPANY, 626 Equitable Building, Baltimore, Md., has been chartered by C. John Beeuwkes, Reuben Oppenheimer and Arthur W. Button.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BRIDGEWATER, VT. — The Bridgewater Woolen Company is erecting a 13,200-volt transmission line from Woodstock to Bridgewater, a distance of 6 miles, to secure electricity to operate its mill. Transformers of 300 kva. capacity will be installed. Energy will be supplied by the Vermont Hydro-Electric Corporation, Rutland, and the Woodstock (Vt.) Electric Company. C. D. Spencer, chief engineer of the Vermont company, is in charge of the work.

BEVERLY, MASS.—The new contract for street-lighting with the Beverly Gas & Electric Company passed by the Board of Aldermen provides for replacing all the present magnetite-arc lamps with lamps of 1,000 cp. The new contract will require an appropriation of $63,000 against $56,000 last year.

SOMERVILLE, MASS.—Work will soon begin on the construction of the proposed local plant of the Ford Motor Company. The first unit, consisting of building, machinery and power plant, will cost about $4,000,000. The second unit, to be erected later, will cost about $2,000,000, making the total cost about $6,000,000.

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received at the office of the Mayor, City Hall, New York, until Dec. 18 for furnishing and installing electric lighting fixtures in the armory of the Twenty-third (106th Regimen, Infantry), at 1323 Bedford Avenue, Borough of Brooklyn.

BROOKLYN, N. Y.—Bids will be received by William H. Gompert, architect, superintendent of school buildings, Board of Education, Flatbush Avenue Extension and Concord Street, Brooklyn, until Dec. 15 for electric lighting equipment in Public Schools 62, 65, 70, 86, Maxwell Training School for Teachers and new telephone system for Erasmus Hall High School, Borough of Brooklyn.

BROOKLYN, N. Y.—Bids will be received by Richard E. Enright, Police Commissioner, Bookkeeper's Office, Headquarters of the Police Department, 240 Centre Street, New York, until Dec. 15 for furnishing and installing electric elevators and equipment, entrance and cabs, at the new Ninety-second precinct police station house, prison and garage, located at Bergen Street and Sixth Avenue, Borough of Brooklyn.

CLINTON, N. Y.—The Public Service Commission has granted the Utica Gas & Electric Company, Utica, permission to construct and operate an electric distributing system in Clinton. The company has taken over the municipal plant, which it will rebuild and furnish a twenty-four-hour service. The cost is estimated at from $7,000 to $10,000.

IRONDEQUOIT, N. Y.—A petition has been presented to the Town Board asking for the installation of 250 lamps along Point Pleasant Road, near Lake Ontario. The Rochester (N. Y.) Gas & Electric Company offers to pay the cost of the installation if the town will pay for maintenance, which will be about $6,500 annually. Irondequoit has not a post office.

NEW YORK, N. Y.—The installation of traffic signals, on First Avenue, similar to those on Fifth Avenue is under consideration by the Police Department.

NEW YORK, N. Y.—Bids will be received by William Wirt Mills, commissioner of plant and structures, Eighteenth Floor, Municipal Building, until Dec. 17 for electrical equipment of a housing station and destructor for the Department of Street Cleaning at 139th Street and Harlem River.

NEW YORK, N. Y.—Plans are being prepared by the Department of Public Markets, Municipal Building, for the construction of a refrigerating plant on Exterior Street, to cost about $325,000. E. O'Malley is commissioner.

ROCHESTER, N. Y. — The American Laundry Machinery Company plans to install electric power equipment in its proposed addition, to cost about $300,000. John J. Strohle, Rochester, is architect.

RUSHFORD, N. Y.—The Genesee Valley Power Company, Fillmore, has been granted a franchise to supply electricity here. The company also has a contract for street lighting.

BROWNSVILLE, PA.—Negotiations are under way between the Borough Council and the West Penn Power Company for improvements to the street-lighting system. The present plan is to erect an ornamental lighting system the entire length of the borough, consisting of twenty-three 1,000-cp. lamps erected on ornamental steel poles, together with four 600-cp. lamps on Broadway. It is also proposed to increase the candlepower of all lamps in the borough from 100 cp. to 250 cp.

GLASSMERE, PA.—Officials of the Ford Glass Company announce that a new power plant, to cost about $1,500,000, will be erected at Glassmere next spring in connection with its glass works.

KINGSTON, PA. — Ground has been broken for a new substation at Schuyler Avenue and Pringle Street by the Luzerne County Gas & Electric Company, to cost about $100,000. Work will soon start on a duplicate of the Kingston station in Nanticoke. Improvements will also be made to the Forty Fort substation. The total cost is estimated at about $200,000.

READING, PA.—The Parish Manufacturing Company plans to install electric power equipment in its proposed plant, which will increase the output of its present plant by 50 per cent. The cost is estimated at $200,000.

SHEPPTON, PA.—Local residents have asked the Pennsylvania Power & Light Company, Allentown, to submit estimates of the cost of lighting the streets of the borough. The company already furnishing electricity for residences and power service.

WASHINGTON, D. C.—Bids will be received by the General Purchasing Officer, Panama Canal, until Dec. 23, for power cable, electrical wire, street-lighting globes and other equipment (Panama Circular 1643).

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, Washington, until Dec. 18, for 2,000 telephone condensers, 3,000 hand telephone receivers, 700 desk telephones, 300 wall telephones, 3,600 telephone head transmitters, 400 transmitter heads and three switchboard tools (Circular C. P. 19580-1).

North Central States

DETROIT, MICH.—The Detroit Edison Company is said to be arranging a bond issue of $12,500,000, for which permission recently has been granted, the entire proceeds to be used for extensions and improvements.

HILLSDALE, MICH.—The City Council has authorized the Board of Public Works to extend the ornamental lighting system

next summer on Broad Street to the fair grounds, on Howard Street to Hallett, on North Street from Howell to Manning Street, on McCollum Street from Howell Street to the fire station and possibly to Manning Street.

CLEVELAND, OHIO.—Bids will be received by the Commissioner of Purchase and Supplies, City Hall, until Dec. 19 for cedar poles, boiler heaters, "white way" lanterns and series-multiple transformers for the Division of Light and Power. Separate proposals are to be submitted for each item.

HAMILTON, OHIO.—The City Council has decided to appropriate $100,000 for repairs to the municipal electric distributing system, the money to be taken from the fund of $650,000 derived from the sale of bonds for rebuilding the municipal electric plant.

JACKSON, OHIO. — Negotiations are under way between the City Council and the Ohio Power Company with a view of the latter supplying electricity to operate the municipal electric plant. The Ohio company is desirous of erecting a transmission line to Ironton by the way of Wellston and Jackson.

MARTINS FERRY, OHIO. — Bids will soon be called for a new combined light and water plant, to cost about $400,000. R. R. Schweitzer, Windsor Hotel, Wheeling, W. Va., is consulting engineer.

FILLMORE, IND.—The Wabash Valley Electric Company, Clinton, is negotiating for the purchase of the local electric plant and plans to furnish service here. Extensions and improvements will be made.

SHOALS, IND.—The installation of a municipal electric light and power plant during 1925 is under consideration by the Town Council.

ROCK ISLAND, ILL.—Steps have been taken by property owners and residents of Rock Island to secure a new street-lighting system for the city.

ASHLAND, WIS.—Plans are being considered for establishing a lighting system, using 250-cp. lamps, on the Gogebic range between the cities of Ironwood and Ramsay, Mich., energy for which will be supplied by the Lake Superior District Power Company, Ashland. The present plans provide for lighting the highway a distance of 10 miles, which may possibly be extended 4 miles later on.

RHINELANDER, WIS.—The plant and holdings of the Rhinelander Light & Power Company, which operates in Rhinelander, Crandon, Monico, Pelican Lake and Eicho, have been acquired by the Wisconsin Valley Electric Company, Wausau. The latter company plans to erect a high-tension transmission line to connect its systems in Tomahawk and Rhinelander

WAUSAU, WIS.—Plans have been completed by the Wisconsin Valley Electric Company for the erection of a six-mile, 6,600-volt transmission line from Polonia to the Rosholt-Nelsonville line, now under construction by the Amherst (Wis.) Electric Service Company.

BEMIDJI, MINN.—The Minnesota Electric Light & Power Company is reported to be planning for the construction of a hydro-electric generating plant on the Mississippi River, near here. A present station will also be remodeled and improved.

CANBY, MINN. — Extensions contemplated by the Union Public Service Company include the erection of a transmission line between Canby and St. Leo.

ELLSWORTH, MINN.—The citizens have voted to lease the municipal electric distributing system to the Minnesota Electric Distributing Company, Minneapolis, which now supplies electricity for local service.

BURT, IOWA.—The Iowa Falls Electric Company, Cedar Rapids, is reported to be negotiating for the purchase of the municipal electric plant.

HOPKINTON, IOWA.—The local electric light and power plant has been acquired by the Iowa Electric Company, Cedar Rapids.

LONE ROCK, IOWA.—At an election held recently the proposal to sell the municipal electric plant to the Iowa Falls Electric Company, Cedar Rapids, was carried.

ST. LOUIS, MO.—The Board of Public Service plans extensions and improvements in the street-lighting system. The work will be carried out in connection with a public improvement program during 1925, to cost about $11,955,000.

TURTON, S. D.—The Northwestern Public Service Company, Armour, has been granted a twenty-year franchise to supply electricity in Turton. A high-tension transmission line will be erected from Conde to furnish service here.

WEBSTER, S. D.—The voters have approved the proposal to sell the municipal electric plant to the Northwestern Public Service Company, Armour. A high-tension transmission line will be erected from Bristol to Webster, which will be extended to Roslyn and Grenville, where the company has been granted franchises. Alternating-current equipment will be installed in the local power plant, which will be used for emergency.

YANKTON, S. D. — The Northwestern Public Service Company, Armour, contemplates additions and improvements in its local power plant, to cost about $100,000.

WYNOT, NEB.—The Minnesota Electric Distributing Company, Minneapolis, has submitted a proposal to the Village Board offering to purchase the municipal electric system.

Southern States

ELIZABETH CITY, N. C.—The Board of Aldermen is arranging a bond issue of $550,000 for the purchase of the local electric light and water systems. Extensions will be made in the lighting system, including the installation of additional equipment.

RALEIGH, N. C.—The Yadkin River Power Company is planning to erect a 60,000-volt transmission line from Blewitt Falls to Morven. It proposes to supply electricity in Chesterfield, Ruby, Mount Croghan and Pageland, all in South Carolina.

COLUMBIA, S. C.—The construction of a substation in Columbia is under consideration by the Broad River Power Company in connection with its new 110,000-volt steel-tower transmission line from Columbia to Parr Shoals and Spartanburg. At this station energy will be stepped down to 33,000 volts for transmission to outlying sections and 13,000 volts for distribution in the city, including a new "belt line" which is planned. Encircling the city through its outskirts, this proposed line will extend direct power service to all sites in the city available for industrial development.

DENMARK, S. C. — The Edisto Public Service Company contemplates extensions and improvements to its plant.

BARTOW, FLA.—In a report submitted by C. V. Turner, city manager, he recommends that bond issues aggregating $283,000 be submitted to the taxpayers, of which $175,000 would be used for extensions and improvements to the municipal power plant and $33,000 for rebuilding and extensions to the municipal distribution system.

FROSTPROOF, FLA.—Plans are under consideration for the installation of an ornamental lighting system in the downtown district.

MADISON, FLA.—The installation of an ornamental lighting system in the business district is under consideration by the Council.

ORLANDO, FLA. — The Florida Associated Engineers, Bus Terminal Building, have tentative plans under consideration for the construction of an electric lighting plant for residential service in connection with the development of a tract of property on Lake Crescent and Lake Butler.

TAMPA, FLA. — The Tampa Electric Company has appropriated $200,000, for the installation of underground conduits in different parts of the city.

CHATTANOOGA, TENN.—The Southern Cities Power Company contemplates extensions in its transmission lines.

BIRMINGHAM, ALA.—The Mississippi Power Company, recently organized by interests connected with the Alabama Power Company, Birmingham, plans extensions of transmission lines into Mississippi. J. M. Berry is president of the new company.

TALLADEGA, ALA. — Steps have been taken by the Chamber of Commerce for the installation of an ornamental lighting system in the city.

VERBENA, ALA. — Gulledge Brothers contemplate building a hydro-electric power plant near here, and will purchase waterwheel and other equipment in the near future.

BELCHER, LA.—Gleason Brothers are considering the construction of an electric light and power plant in Belcher for local commercial service.

NEW ORLEANS, LA.—The New Orleans Public Service, Inc., has issued $2,134,000 in capital stock, part of the proceeds to be used for extensions and improvements.

HOLLIS, OKLA.—Bonds to the amount of $100,000 have been voted, the proceeds to be used for new waterworks, including mains, pumps, reservoir, transmission line, etc. The Gant Baker Company, 1116 West Main Street, Oklahoma City, is engineer.

HOMINY, OKLA.—The People's Light & Power Company, recently organized, plans to install a local light and power system. P. A. Wilkins and L. A. Camp, Hominy, are interested in the company.

MADIL, OKLA.—Preliminary plans are under way for a new electric plant, to cost about $50,000. Oil engines will be used for motive power. K. B. Carson, Madill, is engineer.

SAND SPRINGS, OKLA. — The Pierce Oil Corporation, Bank of Commerce Building, St. Louis, plans to build an addition to the power plant at its local oil refinery.

AUSTIN, TEX.—The installation of a lighting plant at the Capitol is under consideration by the State Board of Control.

LUBBOCK, TEX.—The Texas Utilities Company is planning to install a 1,200-hp. engine at its plant and to extend its transmission system to a number of towns of northwestern Texas. The company has secured a contract from the board of trustees of the new State Technological College at Lubbock under which it will furnish electricity to the institution for a period of twenty years.

MATADOR, TEX. — The plant of the Matador Electric Company has been taken over by the municipality. The system, it is stated, will be turned over to other private interests, which will make extensions and improvements to the service.

MIDLAND, TEX.—New equipment will be installed in the local electric plant of the Southern Ice & Utilities Company, Dallas. The company also contemplates extending its service to Stanton.

SAN ANTONIO, TEX.—Steps have been taken by property owners on Broadway to extend the ornamental lighting system from Tenth Street to the city limits at Alamo Heights. The plans call for 130 lamps of 200 cp., bracket type, with "Novalux" fixtures.

Pacific and Mountain States

COUPEVILLE, WASH. — The Whidby Light & Power Company, Olympia, has submitted a proposal to the Department of Public Works offering to supply electricity for domestic and commercial purposes and for street lighting in Coupeville. P. D. Snyder owner of the Whidby company.

LONGVIEW, WASH.—The City Council is considering the installation of an improved street-lighting system in the Highlands district.

LONGVIEW, WASH. — The Long-Bell Lumber Corporation, Kansas City, Mo., is planning to install electric power equipment in connection with proposed extensions in its local mill to increase the output from 250,000,000 ft. to 400,000,000 ft. per annum.

PORT ANGELES, WASH. — The City Commission is considering the installation of an improved lighting system on Front, Lincoln and First Streets in the business section.

SEDRO-WOOLLEY, WASH.—The Sedro-Woolley Veneer Company is planning to install electric power equipment in connection with the proposed rebuilding of its mill, recently damaged by fire with a loss of about $200,000.

SPOKANE, WASH. — The Washington Water Power Company has petitioned the Federal Power Commission for permission to erect a 20-mile transmission line in Grant County.

PORTLAND, ORE. — Steps have been taken by the Linnton Improvement Club for the installation of an improved lighting system on the St. Helens Road.

SALEM, ORE.—The installation of improved street-lighting systems on State and Twenty-fourth Streets is under consideration by the City Council.

SALEM, ORE. — Two applications for water-power developments have been filed in the office of the State Engineer, one by J. N. Hart, Portland, for water rights on the Deschutes River for the development of 34,000 theoretical horsepower in Wesco County, to cost about $4,000,000, and the other by James R. Wheeler, Winchester, for water from Mills Creek, to develop 1,500 hp. in Douglass County, to cost about $60,000.

CLAYTON, CAL.—The substation of the Great Western Power Company, 530 Bush Street, San Francisco, was recently damaged by fire, causing a loss of about $100,000.

LONG BEACH, CAL.—The Pacific Electric Railway Company plans to build a substation at Long Beach, to cost about $20,000.

LOS ANGELES, CAL.—The City Council has authorized the installation of ornamental lamps on the following streets and will ask bids at an early date: Highland Avenue, 143 pressed steel standards; Beachwood Drive, thirty-four concrete standards; Bronson Avenue, ten pressed steel standards, and Gower Street, nineteen concrete standards.

LOS ANGELES, CAL.—The Grand Avenue Improvement Association has petitioned the City Council to authorize the installation of ornamental lamps on Grand Avenue from Pico to Thirty-eighth Street. Property owners on Wilcox Avenue have applied to the Council for the installation of ornamental lamps on that thoroughfare from Santa Monica Boulevard to Melrose Avenue.

OAKLAND, CAL.—Plans are being prepared by Carl E. Hardy, superintendent of the electrical department, for a new street-lighting system for the downtown district.

RIVERSIDE, CAL.—The Southern Sierras Power Company has applied to the Federal Power Commission for permission to erect about 100 miles of transmission lines and 111 miles of telephone lines in Imperial and San Diego Counties.

SAN DIEGO, CAL.—Application has been made to the Federal Power Commission by the San Diego Consolidated Gas & Electric Company for a permit to erect a transmission line in San Diego County.

BOISE, IDAHO.—The City Council is considering the construction of a municipal electric power plant in the Clear Lake section. C. C. Stevenson is city engineer.

OGDEN, UTAH.—Petitions have been presented to the City Commissioners by property owners in the business section, covering three districts. Plans for district No. 1 call for three-lamp clusters to each post, sixteen to burn all night and 152 to burn until midnight; district No. 2 calls for 341 lamps to burn until midnight and fifty-one all night, and district No. 3 calls for two-lamp standards, nine lamps to burn all night and fifty-seven lamps to burn until midnight.

BENSON, ARIZ.—The installation of an electric light plant in Benson is under consideration. A. G. Smith is reported interested in the project.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association plans to install electrically operated pumps in connection with irrigation system extensions, to cost about $450,000.

WALSENBURG, COLO.—Plans are under consideration by the Trinidad (Col.) Electric Transportation & Electric Power Company for improvements to its local system, to cost about $30,000.

Canada

WINNIPEG, MAN.—Plans, it is stated, have been completed for a power plant at Slave Falls, to cost $3,000,000, and a transmission line to Winnipeg, to cost $2,000,000 for the Manitoba hydro-electric system. No date has been set for the commencement of the work, which will depend upon the final settlement of the dispute regarding the control of the Norman Dam.

COATICOOK, QUE.—Plans are under way for a hydro-electric development on the Coaticook River by the city of Coaticook, for which bids will soon be asked. The project includes utilizing the upper half of the gorge on Coaticook River, developing 1,850 hp. under 145-ft. head, construction of dam and tunneling through 1,500 ft. of rock to North Coaticook, where power house will be built. E. O. Baldwin is Mayor.

MACKAYVILLE, QUE. — The North Shore Power Company, Three Rivers, has been granted permission to install a distributing system in Mackayville.

YAMACHICHE, QUE.—Application has been made to the Public Service Commission by the North Shore Power Company, Three Rivers, to erect a 2,000-volt transmission line between Three Rivers and Yamachiche to supply electricity to the Marconi Company for a large radio station.

Electrical Patents

Announced by U. S. Patent Office

(Issued November 18, 1924)

1,515,593. HEATING ROCK-DRILL BITS AND THE LIKE; William Elsdon-Dew, Leslie Pryce and Leon B. Woodworth, Johannesburg, Transvaal, South Africa. App. filed Jan. 13, 1923. For tempering.

1,515,631. SWITCHING DEVICE; Herbert B. Taylor, Westfield, N. J. App. filed Nov. 7, 1921. For the interconnection of an electrical circuit, as a telephone line.

1,515,632. AUTOMATIC TELEPHONE SWITCH; Herbert B. Taylor, Westfield, N. J. App. filed Nov. 19, 1921. Cross-bar type.

1,515,634. ELECTRICAL MEASURING INSTRUMENT; C. E. Vawter, Philadelphia, Pa. App. filed Oct. 10, 1919. Low-resistance-differential-indicating-ohmmeter type.

1,515,635. INDUCTANCE COIL FOR RADIO COMMUNICATION; Lewis E. Wackerle, Jacksonville, Ill. App. filed April 2, 1923.

1,515,643. TRANSMISSION CIRCUITS; Sumner B. Wright, East Orange, N. J. App. filed Nov. 3, 1923. For telephonic transmission.

1,515,644. ELECTRICAL IGNITER; James Wyld, Queen's Island, Belfast, Ireland. App. filed April 25, 1921. For igniting oil-furnace burners.

1,515,650. TUMBLER SWITCH; Harold G. Baxter, Baldwin, Long Island, N. Y. App. filed Jan. 8, 1921.

1,515,652. ELECTRIC BATTERY; Harry F. French and Raymond C. Benner, Fremont, Ohio. App. filed July 30, 1919. Dry-cell type.

1,515,660. MEASURING INSTRUMENT FOR VACUUM TUBES; George Crisson, Hackensack, N. J. App. filed Sept. 9, 1921.

1,515,666. TERMINAL CLIP; James K. Elderkin, Newark, N. J. App. filed May 19, 1922.

1,515,669. SWITCHING DEVICE; Oscar F. Forsberg, Yonkers, N. Y. App. filed Nov. 15, 1921. In which a multiplicity of electrical circuit connections are established by the co-operation of contact elements.

1,515,670. RADIO TELEGRAPHY; Leonard F. Fuller, Barberton, Ohio. App. filed Sept. 25, 1919. Transmission system.

1,515,674. TELEPHONE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed Dec. 23, 1920. Private-branch exchange system.

1,515,684. THERMOSTATIC CONTROLLER; Arthur J. Kercher, Berkeley, Cal. App. filed March 26, 1923. For use in connection with heating appliances.

1,515,692. METHOD OF WELDING METALLIC STRUCTURES; Royal Mattice, Philadelphia, Pa. App. filed Feb. 9, 1924.

1,515,696. POWER CONTROLLER; Lawrence Pignani and Frank Pignani, Blairsville, Pa. App. filed Sept. 10, 1923.

1,515,713. SWITCH; Stanley C. Williams, Hartford, Conn. App. filed April 13, 1920. Relay switch.

1,515,719. MAGNETIC PULLEY; John P. Bethke and George H. Fobian, Milwaukee, Wis. App. filed Nov. 26, 1920.

1,515,729. ELECTRICAL HEATER; Edward E. Clement, Ocean City, N. J. App. filed May 13, 1921. For heating fluids.

1,515,730, 1,515,731. COMBINATION FAN AND HEATER; Edward P. Cole, Chicago, Ill. App. filed June 23, 1921.

1,515,735. MACHINE-SWITCHING TELEPHONE SYSTEM; Charles L. Goodrum, New York, N. Y., and John N. Reynolds, Greenwich, Conn. App. filed July 21, 1921.

1,515,738. STORAGE-BATTERY SEPARATOR; Lawrence C. Hiatt and Dallas L. Porter, Atlantic, Iowa. App. filed Sept. 24, 1921.

1,515,755. SUSPENSION INSULATOR; Fritz Rohde, Berlin, and Max Schwinning, Berlin-Schoneberg, Germany. App. filed Oct. 12, 1920.

1,515,759. SWITCHING APPARATUS; William M. Scott, Tredyffrin Township, Chester County, Pa. App. filed Feb. 23, 1921. Inclosed-type circuit breaker.

1,515,800. ELECTRIC CONDENSER COFFEE URN; George A. Storey, Holtville, Cal. App. filed Sept. 25, 1923.

1,515,837. PRIVATE AUTOMATIC EXCHANGE; William A. Chapin, Chicago, Ill. App. filed Oct. 24, 1921. Telephone.

1,515,860. ELECTRICAL CONNECTOR; Alonzo Howard, Chicago, Ill. App. filed March 26, 1923. For making connection with a live circuit.

1,515,864. METHOD OF TESTING INSULATORS; Grover W. Lapp, Le Roy, N. Y. App. filed July 7, 1922.

1,515,871. CABLE-RETAINING MEANS; Edward B. Nowosielski, Bloomfield, N. J. App. filed Feb. 11, 1921. For attaching cables to a terminal or connecting block.

1,515,888. ELECTRICAL STEAM-WHISTLE INSTALLATION FOR BOATS; Frank L. Saunders, Ashtabula, Ohio. App. filed Feb. 16, 1920.

1,515,889. DYNAMO-ELECTRIC MACHINE; Theodor Schou and S. Glen Vinson, Mansfield, Ohio. App. filed Jan. 7, 1922. Means for ventilation and for holding the core laminations in place.

1,515,891. QUICK-DETACHABLE CONNECTOR; Charles M. Shay, Orange, N. J. App. filed Jan. 29, 1921. For a cable.

1,515,900. DETECTOR FOR USE IN RADIO CIRCUITS; Charles J. Everett, New York, N. Y. App. filed May 5, 1922. Crystal type.

1,515,912. DRY CELL; William M. Turnley, Toronto, Ontario, Canada. App. filed May 7, 1924.

1,515,932. ELECTRIC SWITCH; Frank D. Crowder, San Francisco, Cal. App. filed Nov. 23, 1920. Master switch.

1,515,945. COATED DRY CELL AND PROCESS OF MAKING THE SAME; Harry F. French, Fremont, Ohio. App. filed June 30, 1919.

1,515,951. AUTOMATIC TELEPHONE SYSTEM; John H. Homrighous, Oak Park, Ill. App. filed May 28, 1919.

1,515,954. COMBINATION ELECTRIC AND COAL BOILER; Charles R. Kline, Reading, Pa. App. filed Feb. 14, 1923.

1,515,967. ELECTRIC FURNACE; Harry C. Reagan, Boulder, Col. App. filed Feb. 24, 1920. For smelting ores or other fusible materials.

1,515,971. ELECTRIC GENERATOR; George H. Sethman, Denver, Col. App. filed Sept. 7, 1920. In which the inductive action is periodically interrupted in a cyclic operation.

1,515,990. WIRELESS TELEGRAPHY; Raymond D. Bangay, London, England. App. filed July 9, 1921.

1,515,994. OSCILLATION DETECTOR; Albert W. Bowman, Winthrop, Mass. App. filed April 4, 1923. Crystal type.

1,516,039. SANITARY ATTACHMENT FOR TELEPHONES; David L. Davis, Portland, Ore. App. filed Oct. 15, 1923.

1,516,054. DUPLEX TOASTER; Alice L. Mottlau, Far Rockaway, N. Y. App. filed Sept. 29, 1920. In which the material is heated simultaneously on both sides.

1,516,060. AMPLIFIER; John T. Rhamstine, Detroit, Mich. App. filed April 22, 1922. For use in connection with telephones.

1,516,061. WIRELESS RECEIVING SYSTEM; Harry O. Rugh, Chicago, Ill. App. filed Nov. 16, 1922.

1,516,112. LIQUID-TREATING APPARATUS; Frank N. Moerk, Philadelphia, Pa. App. filed July 10, 1923.

1,516,122. GALVANIZING APPARATUS; John C. Scarles, Oakland, Cal. App. filed March 1, 1922.

1,516,128. ELECTRIC BOUDOIR LAMP; Charles Wachtel, New Hyde Park, N. Y. App. filed June 28, 1923.

1,516,133. OPHTHALMOSCOPE CONNECTION FOR DRY-BATTERY HANDLES; William N. Allyn, Auburn, N. Y. App. filed Aug. 14, 1922.

1,516,144. ELECTRIC CHAIN-PULL SWITCH; Hugh L. Boggs, Muncie, Ind. App. filed Feb. 20, 1923.

1,516,195. INSTANTANEOUS SWITCH; Arthur Lewerenz, Berlin, Germany. App. filed May 28, 1923. Thermal type.

1,516,203. THERMOSTATICALLY CONTROLLED ELECTRIC HEATING DEVICE; Sterling A. Oakley, Boise, Idaho. App. filed May 23, 1923. For incubators.

1,516,216. CIRCUIT CLOSER FOR BURGLAR ALARMS; Ludwik S. Stankiewicz, Chicago, Ill. App. filed Dec. 22, 1919.

1,516,231. PUSH-BUTTON SWITCH; Stephen S. Grady, Newtonville, Mass. App. filed March 2, 1923.

1,516,245. AUTOMATIC TELEPHONE SYSTEM; Winfred T. Powell, Rochester, N. Y. App. filed Nov. 17, 1920.

1,516,254. HOMOPOLAR DYNAMO; George S. Towar, Toledo, Ohio. App. filed Aug. 1, 1921.

1,516,259. ELECTRIC CIGAR LIGHTER; George J. Vogel and David Damberg, Seattle, Wash. App. filed Oct. 13, 1923.

1,516,260. INCLOSED-DIAPHRAGM BUZZER; Frank W. Wood, Montclair, N. J. App. filed Aug. 7, 1919.

1,516,313. INDICATOR FOR RELAYS; Hudson R. Searing, New York, N. Y. App. filed Feb. 26, 1921.

1,516,326. MANUFACTURE OF ELECTROLYTIC IRON; Auguste Bouchayer, Grenoble, France. App. filed Oct. 12, 1921.

1,516,365. DISTRIBUTION BOX FOR ELECTRIC CIRCUITS; Didrik Welge, Mason, Nev. App. filed July 14, 1922.

1,516,373. ACCUMULATOR PLATE; Louis De M. Cattley, Llandaff, Wales. App. filed Dec. 31, 1921. Lead type; method of manufacture.

Financial and Corporate

Utility Market Hesitates

Mixture of Gain and Loss Appears as Trading Activity Falls Off Somewhat

FOLLOWING a period of pronounced strength, the market for power and light stocks last week turned generally quieter. Prices fluctuated within a narrower range than had been the case during the week before, and the net changes in some cases were declines and in others advances. The utilities seemed to have reached that period of hesitation that became apparent in the general market and that always follows a sharp forward movement.

Except for the activity in American Gas & Electric Company's shares that resulted from accumulation of the stock by those who wanted to take advantage of the 50 per cent stock dividend, the greatest interest was displayed in the market for Commonwealth Power Corporation's shares. The price of this stock rose something like 13¼ points during the week to a new high record for all time at 120, a price that is more than twice the low level reached earlier in the year. Renewed interest in Commonwealth seems to be based on the belief that the stock had fallen behind the market, when account is taken of the large earnings now being reported after liberal allowances for depreciation. There is also the possibility, of course, that the dividend rate will be increased early next year. The present 4 per cent rate is not permanent.

Declaration of a higher dividend rate for Public Service Corporation of New Jersey had no marked effect on the market price of the stock, the new 5 per cent rate having been pretty well discounted beforehand. Carolina Power & Light common, among the Electric Bond & Share issues, improved its position by 43 points for the week, but a very little buying or selling affects the price of this stock materially. Tennessee Electric Power, United Gas & Electric, American Light & Traction and American Power & Light lost ground.

New Capital Issues

During the week ended December 9 eight electric light and power companies offered new issues of stocks, bonds and notes to the investing public to the amount of $27,725,000, exclusive of the foreign financing, the outstanding feature of the week. The largest individual piece of financing was that done by the North American Utility Securities Corporation, described in detail elsewhere in this issue. The Union Electric Light and Power Company of St. Louis contributed $5,000,000 to the total in general mortgage 5 per cent gold bonds offered at 99 and interest to yield about 5.07 per cent. A similar amount was contributed by the Illinois Power & Light Corporation in first and refunding mortgage gold bonds maturing in 1954, the price being 97 and accrued interest. The Electric Bond & Share Company participated in the week's activities with an offering of cumulative preferred stock amounting to $2,600,000. With the purpose of raising funds for construction the Louisiana Power Company offered 6 per cent first mortgage sinking-fund gold bonds amounting to $2,250,000 at 94 and accrued interest to yield about 6.55 per cent. The Columbus Electric & Power Company was represented with a two-million-dollar flotation of first and refunding mortgage gold bonds, the proceeds to be devoted to a new hydro-electric development now in the course of construction. Among the smaller issues were the Edison Electric Company (Lancaster, Pa.), $575,000 in first and refunding mortgage gold bonds, and the Southern Cities Power Company (Tennessee), $300,000 in two-year 6 per cent notes.

American Gas & Electric Company

By Connecting Its Own Properties in Five States and Tying Up with Other Companies, This Utility Is Developing a Huge Interconnected System

BY PAUL WILLARD GARRETT

THE American Gas & Electric Company's declaration of a 50 per cent stock dividend last week calls attention afresh to the company's romantic growth since it began business in 1907. Several phases of the company's development deserve emphasis, but perhaps the management's crowning achievement is something that is just now taking place. The reference is to the great interconnected system that is being completed.

The company had begun to build transmission lines connecting the group of properties of its subsidiaries before some people had learned the meaning of the word "superpower" and while others were exploiting the term for political purposes. In another month or two the American Gas & Electric Company will have properties in five states connected by its own transmission lines. As the accompanying map shows, the interconnections tie together properties in Michigan, Indiana, Ohio, West Virginia and Kentucky, the line reaching almost to the Tennessee border. This superpower system will be fed primarily from three of the largest steam electric generating stations in the Middle West, namely, the Windsor station, near Wheeling, W. Va.; the Philo station in southeastern Ohio, which went into operation last August, and the Twin Branch, now under construction near South Bend, Ind., and which is expected to go into operation next February. Furthermore, the company's own power system is connected at different points with transmission lines and generating stations of numerous other companies, making the system in its entirety one of the outstanding developments already in operation.

TRANSMISSION LINES OF AMERICAN GAS & ELECTRIC COMPANY

The American Gas & Electric Company is fortunate in its conservative management, particularly since its officials, along with their conservatism, have progressive ideas for getting more business and developing earning power. The company's finances, furthermore, have always been handled by the Elec-

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.

Companies	Bid Price Saturday, Dec. 6	Low 1924	High 1924
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	a 98	94	98
Appalachian Power, 7 per cent	a 92	85½	92
Arkansas Light & Power 7 per cent	a 92	81	96
Asheville Power & Light 7 per cent	a 95	95	99
Central Illinois Public Service 6 per cent	a 85	84	88
Colorado Power 7 per cent	a 92	90	98
Connecticut Light & Power 7 per cent	a105	99	106
Consumers' Power 6 per cent	a 91	85	93
Dayton Power & Light 6 per cent	a 90	84	93
Duquesne Light 7 per cent	a105½	102	108½
Eastern Texas Electric 6 per cent	a101	81	105
Empire District Electric 6 per cent	a 70	70	78
Fort Worth Power & Light 7 per cent	a 97	97	103
Great Western Power 7 per cent	a 96	96	99
Illinois Northern Utilities 6 per cent	86	84	87
Illinois Power & Light 7 per cent	a 93	84	95
Kansas Gas & Electric 7 per cent	a 94	92	97
Long Island Lighting 7 per cent	98½	95½	102
Minnesota Power & Light 6 per cent	89	78	90
Mississippi River Power 6 per cent	a 88	80	90
Nebraska Power 7 per cent	96	89	99
Niagara Falls Power—25	a 28	27	29
Niagara, Lockport & Ont. Power 7 per cent	a101½	99	107
Northern States Power 7 per cent	a 96	91	97
Ohio Public Service 7 per cent	a 93	86	100
Pacific Gas & Electric 6 per cent	a 91	85	93
Penn-Ohio Power & Light 7 per cent	90	84	96½
Pennsylvania Power & Light $7—no par	99	93	99½
Penn. Public Service 7 per cent	a 90	90	100
‡Philadelphia Electric 8 per cent—25	a 38	29½	39½
Southern California Edison 8 per cent	a115½	112	120
Tennessee Electric Power, 6 per cent	a 71	47	71
Texas Power & Light 7 per cent	97	95	97½
Utah Power & Light 7 per cent	96	94	96½
Western States Gas & Electric 7 per cent	a 82	78	86
Yadkin River Power, 7 per cent	98	94	99
Holding Companie			
American Gas & Electric 6 per cent—50	a 45½	41½	46
American Light & Traction	a 93½	91	94½
American Power & Light 6 per cent	a 88½	84	91
American Public Service 7 per cent	a 88	84	95
American Public Utilities 7 per cent	a 88	73	88
American Water Works & Electric 7 per cent	a 99½	89½	99½
Associated Gas & Electric 7 per cent—1 per cent extra—50	a 48	42	52
Carolina Power & Light 7 per cent	a 99	95½	101
Central Indiana Power 7 per cent	a 88	80	93
Cities Service 6 per cent	a 80½	67	83
Commonwealth Power 6 per cent	a 82	72	82
Consolidated Gas 6 per cent—50	a 58	51	59½
Continental Gas & Electric 7 per cent pr. pf.	a 90	69	93
Electric Bond & Share 6 per cent	a102	96½	104
General Gas & Electric—$8—no par	a105	96	105
*Middle West Utilities 7 per cent	a 92	80	92
National Power & Light—$7—no par	a 94	84	96½
North American 6 per cent—50	a 47	43½	50½
Northern Ohio Electric	a 26	16	34
Public Service Corp. of N. J. 7 per cent	a101½	96½	101½
Public Service Corp. of N. J. 8 per cent	a112½	99½	115
Standard Gas & Electric 8 per cent—50	a 49½	46½	49½
‡United Gas Improvement—50	a 57½	55½	58
United Light & Power—$6.50—no par	83½	75½	84
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	a 31	22½	34
Appalachian Power—no par	a 71	66	93
Arkansas Light & Power	a 60	22	63
Brooklyn Edison	a123½	107½	123½
Buffalo General Electric	a170	118	170
Colorado Power	a 33	21	35
*Commonwealth Edison	a136½	126	136½
§Consolidated Gas, Electric Light & Power	a 34	32½	37½
Dayton Power & Light	a150	70	180
Detroit Edison	a115½	102½	115½
|| Edison Electric Illuminating of Boston	a197	163½	197
Long Island Lighting	200	100	200
Mississippi River Power	a 33	18	35
Montana Power	a 70	61½	71
Niagara Falls Power—no par	a 44	42	47
Niagara, Lockport & Ontario Power—no par	a 44	42	47
Northern Ohio Electric—no par	a 8	5	16
Northern States Power	a101	92	106
North Texas Electric	a 67	58	84
Pacific Gas & Electric	a102	90½	104½
‡Penn Central Light & Power—no par	60	57	60
§Pennsylvania Water & Power	129	98½	135½
‡Philadelphia Electric—25	a 38½	29	39½
*Public Service Co. of Northern Illinois	a104	96	104
Puget Sound Power & Light	a 51	43½	61½
Southern California Edison	a103	95	106
Tampa Electric	a170	134	170
Tennessee Electric Power—no par	a 44	20	45
Virginia Power	a 54	16	70
Virginia Railway & Power	a 67	36	72½
West Penn. Co.	a 95	47½	98
Holding Companies			
‡American Electric Power—50	62	22½	62½
American Gas & Electric—no par	a114	43½	115
American Light & Traction	a135	115	148
American Power & Light	a 55½	34½	55½
American Public Utilities	a 75	35	97
American Water Works & Electric	a 32½	24	32½
Carolina Power & Light—no par	a261	82½	261
Cities Service	a168½	140	187
Columbia Gas & Electric—no par	a 45½	33	46½
Commonwealth Power Corp.—no par	a118½	56	118½
Consolidated Gas—no par	a 78½	60½	78½
Continental Gas & Electric	a 85	49	96
Federal Light and Traction	a103	75	111½
General Gas & Electric	a 61	22	63
Lehigh Power Securities—no par	a 87	31	89
*Middle West Utilities—no par	a 75½	41	86
National Power & Light—no par	a187	60	190
Philadelphia Co.—50	a 55½	42½	55½
Power Securities—no par	a 18	4	18
Public Service Corp. of N. J.—no par	a 67½	39	69½
Standard Gas & Electric—no par	a 41½	31½	41½
United Gas & Electric (Conn.)—no par	a 32	14	42
Utah Securities	a 39½	16½	39½
BONDS			
Operating Companies			
Adirondack Power & Light 6s 1950	a102½	97½	103
Alabama Power 5s 1946	a 96	90½	97
Appalachian Power 5s 1941	a 96	89	96
Brooklyn Edison 5s 1949	100½	97½	102½
6s 1930	a104	102½	106½
7s 1940	107½	107	110½
Cleveland Electric Illuminating 5s 1939	a100	98½	101
Commonwealth Edison 5s 1943	a 99½	95	101
5s 1953	a 98½	92	99½
§Consol. Gas, Elec. Lt. & Pwr. 4½s 1935	95½	91	96
6s 1949	a105½	102½	106
Consumers' Power 5s 1936	a 98½	94½	99½
5s 1952	91½	87	92½
Detroit Edison 5s 1933	a100	99	101½
Duquesne Light 6s 1949	a106	103½	106½
Great Western Power 5s 1946	95	90½	96
Kansas City Power & Light 5s 1952	a 95½	89	96
Mississippi River Power 5s 1951	a 97½	92	97½
Montana Power 5s 1943	a 97½	95	99
New England Power 5s 1951	a 99½	97	101½
New York Edison 6½s 1941	a114	109½	114½
Niagara Falls Power 6s 1950	a105½	104	106
Northern States Power 5s 1941	a 94	89½	94½
6s 1941	104½	101	105
Ohio Power 7s 1951	a106½	103	107
Pacific Gas & Electric 5s 1942	a 93½	90½	95
Pennsylvania Water & Power 5s 1940	a 99½	96	100
‡Philadelphia Electric 5s 1966	a101	97	103½
5½s 1947	a104½	99½	105
6s 1941	a106½	103½	107½
Portland Electric Power 6s 1947	a 94½	89½	97
Southern California Edison 5s 1939	a 99½	96	100
6s 1944	a102½	100	103½
Tennessee Electric Power 6s 1947	a 99½	93½	99½
Texas Power & Light 5s 1937	97	91½	97
Toledo Edison 7s 1941	a109½	106	110
Utah Power & Light 6s 1944	a 91½	87½	93½
Holding Companies			
Alabama Traction, Light & Power 5s 1962	a 83½	65½	86
American Gas & Electric 6s 2014	a 94½	94	95½
American Power & Light 6s 2016	a 93½	91	94½
Amer. Water Works & Electric 5s 1934	a 92½	84½	94
Associated Gas & Electric 6½s 1954	95½	92½	94½
Central Indiana Power 6s 1947	a 95½	88	96½
Commonwealth Power 6s 1947	a 97½	87	98
Consolidated Cities Lt., Pwr. & Tr. 5s 1962	a 75	64	76½
Illinois Power & Light 6s 1953	a101	95	101
United Light & Railways 5s 1932	94	87½	94½
6s 1952	96	92	97½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing	a103½	90	103½
*National Carbon	a122	112	125
Worthington Pump & Machinery—A	a 88	68	88
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 68½	41½	70
American Bosch Magneto—no par	a 28½	22½	38½
Electric Storage Battery—no par	a 65	50½	66
General Electric	a280½	193½	281
General Electric—10	a 11½	10½	11½
*Hurley Machine—no par	a 65½	48	66
†Wagner Electric	26½	20	34½
Westinghouse Electric & Manufacturing—50	a 69½	55½	70½
Worthington Pump & Machinery	a 54½	23½	54½
BONDS			
Canadian General Electric 6s 1942	a107½	102½	107½
General Electric 3½s 1942	84	80	84
5s 1952	105	100	105½
Robbins & Myers 7s 1952	66	66	91½
†Wagner Electric Manufacturing 7s	101	97	101
Western Electric 5s 1944	a 98½	96	99½
Westinghouse Electric & Mfg. 7s 1931	a107½	106½	109½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange. § Baltimore Stock Exchange
a Bid price Wednesday, December 10.

tric Bond & Share Company, an affiliation that gives the American Gas & Electric certain distinct advantages, including the ability to get funds for expansion on favorable terms.

With the properties under excellent management, stockholders may look forward to a greater development in the future than has yet come. There is every reason to believe that the new interconnections will accelerate earning power materially. With the exception of an isolated property in Rockland, Ill., and the rather extensive properties in northeastern Pennsylvania and southern New Jersey, all of the American Gas & Electric subsidiaries will presently be linked together and all of the vast territory will be served primarily by the three large modern generating stations just referred to.

By persistent increases year after year, the gross earnings from operation of the subsidiaries of the American Gas & Electric Company have grown from $1,727,267 in 1907 to $36,369,603 for the twelve months ended October 31, 1924. Net earnings before the deduction of interest charges in the same period have grown from $758,186 to $11,580,243. The figures do not include earnings of the American Electric Power Company properties recently acquired.

Although the name of the American Gas & Electric Company would lead to another conclusion, gas represents a very small part of the company's business. Over 94 per cent of the gross earnings for the twelve months ended October 31 were derived from power and light activities.

Investors who do not understand how the company can afford to pay a 50 per cent stock dividend, following recent liberal payments, should review its financial history. Having been conservatively capitalized and having plowed sizable funds back into the property over a period of years, earning capacity has been developed along sound lines. Stockholders now are able to realize a fair return on capitalization even with a relatively small return on valuation; that is, the valuation has been increased faster than the volume of capital issues.

A balance of $8,365,569 after charges shown for the American Gas & Electric Company for the twelve months ended October 31 is the equivalent of more than $7 a share for the common stock. Payment of the common dividend involves only a dollar a share in cash annually (one-seventh of the amount available), the other part of the dividend consisting of payment annually of two-fiftieths of a share of common stock. Even after the company capitalizes a part of its surplus through declaration of a 50 per cent stock dividend, increasing the number of shares from 813,136 to 1,219,704, the above earnings will represent $4.70 on the larger number of shares, or four or five times the cash requirements of the dividend. Here, again, no account is taken of American Electric Power Company earnings.

Commonwealth Power Corporation.—The Commonwealth Power Corporation and subsidiaries report for twelve months ended October 31 net earnings of $3,789,317 after taxes, interest and depreciation, equivalent after preferred dividends to $10.98 a share on 210,000 shares of common stock. This figure compares with $3,380,186, or $9.24 a share, in the corresponding period of 1923.

American Bankers Again Participate in Foreign Financing

The offering this week of the International Power Securities Corporation's 6½ per cent collateral trust gold bonds, totaling $4,000,000, by Aldred & Company and associates, marks another step in the financing by American interests of public utility development in foreign countries. The International corporation, formerly the Italian Power Company, was organized in 1923 by prominent American bankers and electrical men to acquire the securities of leading electric light and power companies operating in this country and abroad. By this loan the corporation has extended its field of operation to France, the issue being secured by $4,000,000 6½ per cent bonds of the Union d'Electricité, Paris, one of the leading power companies of that country, owning and operating six steam-power plants in the Paris district. The report of the company's operations from January 1 to October 31 shows the generation of 190,000 kw. as compared with 150,000 kw. in 1923. Gross receipts were 102,000,000 francs as against 72,517,000 francs in the previous year. The bonds, maturing in 1954, were offered at 93¾ and accrued interest, to yield about 7 per cent.

Dividends Declared

The following quarterly dividends were announced by central-station companies and electrical manufacturing companies during the past week:

Name of Company	Per Cent	When Payable	
American & Foreign Power, pf	$1.75	Jan.	2
American Gas & Electric, com	25c	Jan.	2
American Gas & Electric, com., ext.*	....	Jan.	2
American Gas & Electric, com., ext.†	50	Jan.	2
American Power & Light, pf	$1.50	Jan.	2
American Pub. Service, pf., capital	$1.75	Jan.	2
American Pub. Utilities, pr., pf	$1.75	Jan.	2
American Public Utilities, ptc., pf	$1.25	Jan.	2
Bangor Railway & Electric, pf	1¾	Jan.	2
Central Illinois Light, 6% pf	$1.50	Jan.	2
Central Illinois Light, 7% pf	$1.75	Jan.	2
Central States Electric, pf	1¾	Jan.	2
Detroit Edison	2	Jan.	15
Illinois Power & Light, 7% cum., pf.	1¾	Jan.	2
Illinois Power & Light, 6% ptc	1½	Jan.	2
Kansas City Power & Light, 1st pf. A	1¾	Jan.	1
Manila Electric	62½c	Dec.	31
Minnesota Power & Light, pf	1¾	Jan.	2
Missouri Power & Light, pf	$1.75	Jan.	2
Monon W. Penn. Pub. Serv., 7% pf.	43¾	Jan.	2
Monon. W. Penn Pub. Serv., 6% pf.	37½	Jan.	2
Niagara, Lockport & Ont. Pwr., com	50c	Jan.	2
Niagara, Lockpt & Ont. Pr., com. ex.	25c	Jan.	2
Niagara, Lockport & Ont. Pwr., pf.	$1.75	Jan.	2
N. American Lt. & Pwr. 7% cum. pf.	1¾	Jan.	2
North West Utilities, pr. lien, pf	$1.75	Jan.	2
Northern Utilities, 7% pr. lien, pf	$1.75	Jan.	2
Pub. Serv. Corp. of N. Jersey, com.	$1.25	Dec.	31
Pub. Serv. Corp. of N. Jersey, 7% pf.	$1.75	Dec.	31
Pub. Serv. Corp. of N. J., 8% cum. pf	$2.00	Dec.	31
Springfield Railway & Light, pf	1¾	Jan.	2
Toledo Edison, pf	2	Jan.	2
United Gas & Electric, pf	1¾	Jan.	1
United Light & Power, com. A & B	40c	Feb.	2
United Light & Power, pf. A	$1.62	Jan.	2
United Light & Power, pf. B	$1	Jan.	2
Utah Power & Light, pf	1¾	Jan.	2
Wisconsin Power & Light, pf	$1.75	Dec.	15
Allis-Chalmers Mfg. pf	$1.75	Jan.	15
Babcock & Wilcox, extra	3	Jan.	2
Canadian General Electric, pf	1¾	Jan.	1
Emerson Electric, pf	1¾	Jan.	1
Manhattan Electric Supply	$1	Jan.	2
Westinghouse Electric & Mfg., com.	$1	Jan.	31
Westinghouse Electric & Mfg., pf	$1	Jan.	15

* 1/50 share of common stock.
† In common stock.

North American Utility Securities Corporation

The North American Utility Securities Corporation has been organized and has issued 100,000 shares of cumulative first preferred stock. With each share of first preferred stock purchased will be delivered one share of common stock. Following the first preferred stock there will be outstanding 60,000 shares of second preferred stock. The first preferred stock is entitled to cumulative dividends at the rate of $6 per share per year. The second preferred is entitled to cumulative dividends at the rate of $7 per share per year. Following the second preferred stock there will be outstanding 500,000 shares of common stock.

The North American Company, well known in utility circles as one of the large and successful holding companies, has paid into the treasury of the new corporation $6,000,000 cash, for which it is to receive all of the 60,000 shares of second preferred and 400,000 shares (80 per cent) of the common stock. According to the circular issued by the bankers, the North American Utility Securities Corporation "has been organized for the purpose of participating in the financing and development of public utility and other enterprises in America and abroad." The broad terms of this statement make it impossible for the subscribers to form any first-hand opinion on the undertaking. The circular states that "the affairs of the corporation will be administered under the supervision of the North American Company." Thus the purchaser of these units of first preferred and common stock is merely registering his confidence in North American Company management.

The price at which these units or allotment certificates are brought out is $100 each, payable in four equal installments approximately three months apart.

Company Reports

Among the company reports issued during the past week for the month of October are the following:

Name of Company	Gross Revenues for October 1924	1923
American Power & Light	$2,952,511	$2,834,083
Asheville Power & Light	91,046	84,325
Brazilian Traction, Light & Pr.	2,485,495	2,044,655
Carolina Power & Light	268,232	225,056
Grafton County Elec. Lt. & Pr.	18,701	16,540
Los Angeles Gas & Electric	1,393,894	988,521
Penn Central Light & Power	315,686	297,884
Southern Canada Power	90,203	81,519
Southern Power & Light & sub.	1,111,324	1,034,140
Yadkin River Power	168,060	169,225
York Utilities	12,093	13,773

Few Light and Power Bonds in Default.—A recent compilation made by Dow, Jones & Company of public utility corporation bonds at present in default is proof of the excellent record for payment established by the electric light and power companies. Out of a total of seventy companies with securities in default to the amount of $154,866,700, only five electric light and power companies were represented, with securities in default amounting to $6,648,900. Only one of the five issues is in default as to principal as well as to interest, and that a small issue of notes, totaling $281,900.